

# Open Research Online

---

The Open University's repository of research publications and other research outputs

## There's No Rush: Developing a Legal Framework for Space Resource Activities

### Journal Item

#### How to cite:

Cheney, Thomas (2019). There's No Rush: Developing a Legal Framework for Space Resource Activities. Journal of Space Law, 43 pp. 106–150.

For guidance on citations see [FAQs](#).

© 2019 Journal of Space Law



<https://creativecommons.org/licenses/by-nc-nd/4.0/>

Version: Accepted Manuscript

---

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data [policy](#) on reuse of materials please consult the policies page.

---

[oro.open.ac.uk](http://oro.open.ac.uk)

# There's No Rush: Developing a Legal Framework for Space Resource Activities

**Thomas Cheney**

PhD candidate in space law and policy  
Northumbria University, Newcastle Upon Tyne, UK  
thomas.cheney@northumbria.ac.uk

## Abstract

There has been considerable excitement surrounding the regulation of space resource extraction and utilization activities since the 2012 debut of Planetary Resources and Deep Space Industries – pioneering companies which shared the ambitious goal of mining asteroids. This excitement has spawned national legislation in the United States, Luxembourg and potentially more nations. It has also sparked considerable discussion at the main international forum for discussing the international governance of outer space, the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space. Additionally, The Hague International Space Resources Governance Working Group was established as a ‘multi-stakeholder dialogue’ with the aim of developing ‘draft building blocks’ for an ‘international framework’. This article examines what resources exist within our solar system, and the viability of economic extraction of those resources. It considers the nature of celestial bodies and whether differing approaches to extraction and utilization are necessary or at least worthy of consideration. It also discusses the nature and necessity of an international framework, given the potential for conflict over space resources and the need to consider issues of sustainability and equity. Ultimately, this article argues that given the demise of the two asteroid mining pioneers, it is worth taking the time to step back and reconsider our approach to the governance of space resource activities.

## I. INTRODUCTION

In 2012, two United States (“U.S.”) based companies, Planetary Resources, Inc. (“Planetary Resources”) and Deep Space Industries, Inc. (“Deep Space Industries”) announced their existence, and their intention to mine asteroids. Predictions of the dawn of a “space gold rush” and the launch of a trillion-dollar industry were abundant.<sup>1</sup> The U.S. enacted the Space

---

<sup>1</sup>Elizabeth Pearson 'Space Mining: the New Goldrush' Science Focus (11 December 2018) Available at: <https://www.sciencefocus.com/space/space-mining-the-new-goldrush/>; Andrew Wong (2018) 'Space Mining Could Become a Real Thing - And It Could Be Worth Trillions' CNBC (15 May) <https://www.cnbc.com/2018/05/15/mining-asteroids-could-be-worth-trillions-of-dollars.html>; Neel V. Patel (2017) 'Asteroid Mining Could be a Multi-Trillion Dollar Business by 2020' Inverse (28 June) <https://www.inverse.com/article/33556-asteroid-mining-multi-trillion-dollar-business-asteroid-day-2017>; Calla Cofield (2016) 'Extraterrestrial Gold Rush: What's Next for the Space Mining Industry' Space.com (21 November) <https://www.space.com/34774-whats-next-for-space-mining.html>; Morgon Saletta and Kevin Orrman-Rossiter 'All of Humanity Should Share in the Space Mining Boom' The Conversation (17 April 2016) Available at: <http://theconversation.com/all-of-humanity-should-share-in-the-space-mining-boom-57740>; Rob Davies (2016) 'Asteroid Mining Could be Space's New Frontier: The Problem is Doing it Legally' The Guardian (6 February) <https://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues>; 'Luxembourg hits on Goldmine, in space' Luxembourg Times (2 February 2016) <https://luxtimes.lu/archives/8005-luxembourg-hits-on-goldmine-in-space>; Peter Terlatto (2015) 'NASA is Dreaming About Creating a Trillion-Dollar Industry from Asteroid Mining for Precious Metals' Business Insider

Resource Exploration and Utilization Act of 2015 (the “U.S. Space Resource Act” or the “U.S. Act”)<sup>2</sup> to lay the foundation for the “authorization and continuing supervision” of space resource activities.<sup>3</sup> Luxembourg followed suit with their own space resource activities legislation in 2017,<sup>4</sup> and took the additional step of investing in space resource ventures such including Planetary Resources.<sup>5</sup> There was a considerable response from the international community (or at least the segment that pays attention to such things), and the potential regulation of space resource utilization has featured as a topic at the United Nations Committee on the Peaceful Uses of Outer Space’s (“UNCOPUOS”) Legal Subcommittee for the last several years.<sup>6</sup> It has also spawned at least one effort to draft a multilateral “framework” for space resource activities: The Hague International Space Resources Governance Working Group (the “Hague Working Group”).<sup>7</sup> However, the space resources “bubble”<sup>8</sup> may already have burst as both Deep Space Industries and Planetary Resources have been acquired by others<sup>9</sup> and are no longer focused on space mining efforts. There are other companies pursuing space resource activities, but a lot of the wind seems to have gone out of the sails of the industry.<sup>10</sup>

This article explores our approach to the governance of space resource activities. Part II looks at international space law relating to space resource activities. Part III reviews the

---

Australia (20 July) <https://www.businessinsider.com.au/nasa-is-dreaming-about-creating-a-trillion-dollar-industry-from-asteroid-mining-for-precious-metals-2015-7>;

Emily Calandrelli (2015) 'The Potential \$100 Trillion Market for Space Mining' TechCrunch (9 July) <https://techcrunch.com/2015/07/09/the-potential-100-trillion-market-for-space-mining/>; Jon Kelvey (2014) 'Is it Legal to Mine Asteroids' Slate (13 October) <https://slate.com/technology/2014/10/asteroid-mining-and-space-law-who-gets-to-profit-from-outer-space-platinum.html>; Alan Boyle, *Big-time Players are Getting Serious about Asteroid Perils and Profits*, NBC NEWS (APR. 16, 2013), <http://cosmiclog.nbcnews.com/news/2013/04/16/17782885-big-time-players-are-getting-serious-about-asteroid-perils-and-profits?lite>

<sup>2</sup>U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90, §401, 129 Stat. 70 (2015) [hereinafter the U.S. Space Resource Act].

<sup>3</sup>Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies art. VI, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

<sup>4</sup>Loi 674 du 20 juillet 2017 sur l’exploration et l’utilisation des ressources de l’espace [Law 674 of July 20, 2017 on the Exploration and Use of Space Resources], JOURNAL OFFICIEL DU GRAND-DUCHE DE LUX., July 28, 2017, <http://legilux.public.lu/eli/eta1/leg/loi/2017/07/20/a674/jo> [<https://perma.cc/6XX4-KCCE>][hereinafter Luxembourg Space Resource Law].

<sup>5</sup>See Sarah Scoles, *Luxembourg’s Bid to Become the Silicon Valley of Space Mining*, WIRED (Oct. 1, 2017), <https://www.wired.com/2017/01/luxembourg-setting-silicon-valley-space-mining/>; David Z. Morris, *Luxembourg to Invest \$227 Million in Asteroid Mining*, FORTUNE (June 5, 2016), <https://fortune.com/2016/06/05/luxembourg-asteroid-mining/>.

<sup>6</sup>See Comm. On the Peaceful uses of Outer Space, Rep. of the Legal Subcomm. on Its Fifty-Seventh Session, U.N. Doc. A/AC.105/1177 (2018); Comm. On the Peaceful uses of Outer Space, Rep. of the Legal Subcomm. on Its Fifty-Sixth Session, U.N. Doc. A/AC.105/1122 (2017); Comm. On the Peaceful uses of Outer Space, Rep. of the Legal Subcomm. on Its Fifty-Fifth Session, U.N. Doc. A/AC.105/1113 (2016).

<sup>7</sup>See Leiden University, THE HAGUE INTERNATIONAL SPACE RESOURCES GOVERNANCE WORKING GROUP, <https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-for-air-space-law/the-hague-space-resources-governance-working-group> (last visited July 7, 2019). The author is a member of this working group.

<sup>8</sup>Jeff Foust, *The Asteroid Mining Bubble Has Burst*, THE SPACE REVIEW (Jan. 7, 2019), <http://www.thespacereview.com/article/3633/1>.

<sup>9</sup>See Jeff Foust, *Deep Space Industries Acquired by Bradford Space*, SPACENEWS (Jan. 2, 2019), <https://spacenews.com/deep-space-industries-acquired-by-bradford-space/>; Jeff Foust, *Asteroid Mining Company Planetary Resources Acquired by Blockchain Firm*, SPACENEWS (Oct. 31, 2018), <https://spacenews.com/asteroid-mining-company-planetary-resources-acquired-by-blockchain-firm/>

<sup>10</sup>Moon Express - <http://www.moonexpress.com/> and iSpace - <https://ispace-inc.com/>; see also: Chloe Cornish “Interplanetary Players: A Who’s Who of Space Mining” Financial Times (19 October 2017) Available at: <https://www.ft.com/content/fb420788-72d1-11e7-93ff-99f383b09ff9>

national legislation enacted by the U.S. and Luxembourg and the international reaction from both UNCOPOUS and the Hague Working Group. Part IV considers the nature, form and need for a space resources property rights regime. This will include not only contemplating the “value” of property rights for the prospective industry but also the broader repercussions such as: the interests of all countries; sustainability; and potential impacts on the peace and stability of the international order. This article argues that an international space resources framework is necessary to ensure: 1) mutual recognition of property rights to extracted space resources as well as to avoid conflict and harmful interference; 2) that space resource activities do not unduly harm scientific, historical, cultural or aesthetic sites of interest on the Moon or other celestial bodies; and 3) sustainable, equitable access to space resources in the interests and for the benefit of all countries. If the space resources bubble has indeed burst then now may be the time to slow down and reconsider the approach being taken to establish a legal regime to enable and supervise space resource activities. The demise of Deep Space Industries and Planetary Resources will not be the end of the industry and the law and policy that has been developed will lay the foundation for future developments.

## INTERNATIONAL SPACE LAW

The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (the “Outer Space Treaty”) is commonly regarded as the “Magna Carta” of outer space.<sup>11</sup> It has achieved widespread acceptance, having been ratified by 107 states and signed by an additional 23.<sup>12</sup> Its key provisions are generally regarded as having achieved the status of customary international law,<sup>13</sup> and it has been suggested that a few provisions, such as the non-appropriation principle found in Article II have achieved the status of *jus cogens* norms.<sup>14</sup> There are several articles of the Outer Space Treaty that are relevant for space resource activities, however for this paper the three that are most relevant are Articles I, II and VI although a brief discussion of Article IX is also germane.<sup>15</sup> It is also worth briefly discussing Article 11 of the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement).<sup>16</sup> The Moon Agreement does not enjoy the same degree of support, having been ratified by only 18 states but Article 11 discusses space resource activities and is therefore worth consideration.<sup>17</sup>

---

<sup>11</sup>See Fabio Tronchetti, *Legal Aspects of Space Resource Utilization*, in HANDBOOK OF SPACE LAW, 778 (Frans von der Dunk & Fabio Tronchetti eds., Edward Elgar 2015); FRANCIS LYALL & PAUL B. LARSEN, SPACE LAW: A TREATISE, 53 (Ashgate 2009)[hereinafter SPACE LAW: A TREATISE]; Stephan Hobe, *Historical Background*, in COLOGNE COMMENTARY ON SPACE LAW, VOL 1, 14 (Stephan Hobe, Bernhard Schmidt-Tedd & Kai-Uwe Schrogl eds., 1st ed, Carl Heymanns Verlag 2009)[hereinafter COLOGNE COMMENTARY]; I.H.PH. DIEDERIKS-VERSCHOOR & V. KOPAL, AN INTRODUCTION TO SPACE LAW, 3 (3rd ed, Kluwer Law International 2008).

<sup>12</sup>Comm. On the Peaceful uses of Outer Space, Status of International Agreements Relating to Activities in Outer Space as at 1 January 2018, U.N. Doc. A/AC.105/C.2/2018/CRP.3 (2018).

<sup>13</sup>See Paul B. Larsen, *Asteroid Legal Regime: Time for a Change?*, 39 J. Space L. 275, 289 (2014); SPACE LAW: A TREATISE, *supra* note 12 at 54, 71, 180 & 184; Peter Malanczuk, AKEHURST’S MODERN INTRODUCTION TO INTERNATIONAL LAW, 206 (7th ed, Routledge 1997).

<sup>14</sup>See Steven Freeland & Ram Jakhu, *Article II* in COLOGNE COMMENTARY, *supra* note 12 at 55; IMRE ANTHONY CSABAFI, THE CONCEPT OF STATE JURISDICTION IN INTERNATIONAL SPACE LAW: A STUDY IN THE PROGRESSIVE DEVELOPMENT OF SPACE LAW IN THE UNITED NATIONS, 47 (Martinus Nijhoff 1971).

<sup>15</sup>Outer Space Treaty, *supra* note 3.

<sup>16</sup>Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, *opened for signature* Dec. 18, 1979, 1363 U.N.T.S. 3 [hereinafter Moon Agreement].

<sup>17</sup>Comm. On the Peaceful uses of Outer Space, Status of International Agreements Relating to Activities in Outer Space as at 1 January 2019, *supra* note 13.

Article I of the Outer Space Treaty declares that space is free for exploration and use by all States.<sup>18</sup> There is no definition of the terms “exploration” or “use” in the Treaty, therefore under the rules of treaty interpretation, codified in the Vienna Convention on the Law of Treaties, the terms should be interpreted according to their “plain, ordinary meaning.”<sup>19</sup> The ordinary meaning of a treaty term needs to be understood in context with the rest of the treaty and in line with the “object and purpose”<sup>20</sup> of the treaty. However, “plain meaning” is a good place to start,<sup>21</sup> especially as textual analysis takes precedence.<sup>22</sup> Recourse can be made to dictionaries – even specialist dictionaries – to find the “ordinary meaning,” and indeed courts have done so.<sup>23</sup>

“Use” is defined by the *Oxford English Dictionary* as “to take, hold or deploy as a means of achieving something” or “to take or consume (an amount) from a limited supply”<sup>24</sup> which would imply that the plain, ordinary meaning of freedom of use of outer space includes the ability to mine asteroids and other celestial bodies for space resources. The general principle in international law that anything that is not prohibited is permitted<sup>25</sup> applies here. This connects to a ‘voluntarist’ interpretation of international law, in which States, as their own law makers are only bound by that which they have consented to be bound.<sup>26</sup> There is no prohibition on resource extraction *per se* in the Outer Space Treaty,<sup>27</sup> therefore this principle combined with the above described plain ordinary meaning of the term “use” means that it is reasonable to argue that resource extraction is permitted, at least within the bounds of the rest of the space law regime. This argument is further strengthened by considering the “object and purpose” of the Outer Space Treaty. The Treaty’s Preamble stipulates that the States Parties recognize “the common interest of all [hu]mankind in the progress of the exploration and use of outer space for peaceful purposes...”<sup>28</sup> Quite simply, without space resource utilization activities, humanity’s “progress of the exploration and use of outer space” for whatever purposes will be limited.

Article II of the Outer Space Treaty prohibits national appropriation by means of use, occupation, or any other means.<sup>29</sup> While it is clear that this prohibits the acquisition of territory on the Moon or other celestial bodies there is debate about what it means for resources extracted

---

<sup>18</sup> Outer Space Treaty, *supra* note 3 art. I.

<sup>19</sup> Vienna Convention on the Law of Treaties art. 31(1), Jan. 27, 1155 UNTS 331 [hereinafter Vienna Convention].

<sup>20</sup> *Id.*

<sup>21</sup> RICHARD GARDINER, *TREATY INTERPRETATION*, 181, 184-5 (2nd ed, Oxford University Press 2017).

<sup>22</sup> See Max H. Hulme, *Preambles in Treaty Interpretation*, 164 U. PA. L. Rev. 1281, 1297 (2016); Claire Brighton, *Unravelling Reasonableness: A Question of Treaty Interpretation*, 32 AUSTL. YEAR BOOK OF INT’L L. 125, 125 (2014).

<sup>23</sup> Gardiner, *supra* note 22, at 186-189.

<sup>24</sup> *Use*, CONCISE OXFORD ENGLISH DICTIONARY, 1593. 12<sup>th</sup> edition. 2011.

<sup>25</sup> Jorg Kammerhofer (2009) ‘Gaps, The *Nuclear Weapons* Advisory Opinion and the Structure of International Legal Argument Between Theory and Practice’ 80 BYBIL 333, 356-357; Helen Quane (2014) ‘Silence in International Law’ 84 BYBIL 240, 253-260; Carl Q. Christol *Space Law: Past, Present, and Future* (Kluwer Law and Taxation Publishers 1991), 290; (France v. Turkey) (1927) P.C.I.J., Ser. A, No. 10 (‘Lotus’ case), paras 46-47

<sup>26</sup> Michael P. Scharf *Customary International Law in Times of Fundamental Change: Recognizing Grotian Moments* (Cambridge University Press 2013), 48-50; Bin Cheng, *Studies In International Space Law* (Clarendon Press, 1997), 138

<sup>27</sup> That is to say that there is no specific provision that explicitly prohibits resource extraction, arguments that resource extraction is prohibited rest on the non-appropriation principle in Article II of the Outer Space Treaty.

<sup>28</sup> Outer Space Treaty, *supra* note 3, Preamble. See generally Hulme, *supra* note 22, at 1299-1304.

<sup>29</sup> Outer Space Treaty, *supra* note 3, art. II.

from those bodies. There are those who argue that space resource utilization activities would violate Article II of the Outer Space Treaty as resources are part of the object in which they are found and to appropriate the resources would be to appropriate the celestial body, at least in part.<sup>30</sup> If resources are capable of being separated from the celestial body that they are found in, then it would not necessarily be a violation of Article II to appropriate the resource once it has been removed from that body. It is just that the State in question would not acquire any territorial rights over the celestial body being mined. This is the argument that both the United States and Luxembourg have used in support of their national laws.<sup>31</sup>

Article II does have significant implications for jurisdiction, as it prohibits territorial jurisdiction, the established basis for most jurisdictional claims. Thus, States must rely almost exclusively on personal jurisdiction over their nationals in space,<sup>32</sup> as guided by Article VI of the Outer Space Treaty which requires that States authorize and supervise the activities of their nationals in outer space.<sup>33</sup> As a result, many States have implemented national legislation to ensure that the activities of their nationals comply with the requirements of the Outer Space Treaty and international space law in general. Even without Article VI of the Outer Space Treaty it is generally accepted in international law that “every State has the right to regulate the conduct of its subjects wherever they may be.”<sup>34</sup> This is important. States are free to regulate the activity of their nationals in outer space but they are not able to exercise jurisdiction over territory in outer space, this is a line that each of the U.S. and Luxembourg legislation manages to toe.

Article IX of the Outer Space Treaty also warrants a brief mention as its provisions on the avoidance of ‘harmful interference’ and ‘harmful contamination’ are relevant for space resource activities and will need to be further developed and defined as activities commence. The Article stipulates that:

States Parties to the Treaty shall be guided by the “principle of co-operation and mutual assistance and shall conduct all their activities in outer space, including the moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty.”<sup>35</sup>

---

<sup>30</sup>Ulrike M. Bohlmann, ‘Legal Aspects of the ‘Space Exploration Initiatives’ in Marietta Benkö and Kai-Uwe Schrogl eds., *Space Law: Current Problems and Perspective for Future Regulation* (Eleven, 2005) 215-240, 224; Tronchetti, Fabio, ‘The Space Resource Exploration and Utilization Act: A Move Forward or a Step Back?’ (2015) 34 *Space Policy* 6, 7-8; Belgian Delegation, Statement made at UNCOPUOS Legal Subcommittee, 5 April 2016 0928-0929 GMT - <http://www.unoosa.org/oosa/audio/v2/meetings.jsp?lng=en>; German Delegation – Statement Made at UNCOPUOS Legal Subcommittee – 29 March 2017 823-906 GMT - <http://www.unoosa.org/oosa/audio/v2/meetings.jsp?lng=en>

<sup>31</sup>Ministry of the Economy, Grand Duchy of Luxembourg, ‘Explanatory Statement on the Draft Law on the Exploration and Use of Space Resources’ (2016) [https://gouvernement.lu/dam-assets/fr/actualites/communiqués/2016/11-novembre/11-presentation-spaceresources/Draft-law-space\\_press.pdf](https://gouvernement.lu/dam-assets/fr/actualites/communiqués/2016/11-novembre/11-presentation-spaceresources/Draft-law-space_press.pdf), 1-6; US Delegation – UNCOPUOS Legal Subcommittee – 28 March 2017 855-903 GMT; US Delegation – UNCOPUOS Legal Subcommittee – 28 March 2017 1433-1441 GMT; US Delegation – UNCOPUOS Legal Subcommittee – 29 March 2017 923-925 GMT; US Delegation – UNCOPUOS Legal Subcommittee – 29 March 2017 1437-1457 GMT; Sagi Kfir, “Space Resources Utilisation and National Law: The Case of the USA”, Symposium on Legal Aspects of Space Resource Utilisation, 17 April 2016, Leiden Law School, Kamerlingh Onnes Building, Steenshuur 25, 2311ES Leiden

<sup>32</sup>Csabafi, *supra* note 15, at 50-51.

<sup>33</sup>Outer Space Treaty, *supra* note 3, art. VI. States also retain “jurisdiction and control” over their space objects, but that is less relevant for this paper.

<sup>34</sup>Csabafi, *supra* note 15, at 51

<sup>35</sup> Outer Space Treaty, *supra* note 3, art. IX.



States also need to avoid the “harmful contamination” of the Moon and other celestial bodies and take steps to mitigate “harmful interference” with the activities of other States. Parties are to engage in “international consultations” in the event of conflict or potential conflict.<sup>36</sup> “Harmful contamination” and “harmful interference” are not defined by the Outer Space Treaty, and have not enjoyed massive exploration in subsequent development beyond planetary protection principles<sup>37</sup> and ITU rules, regulations, and guidelines.<sup>38</sup> However, the concepts will be discussed further below and are relevant for discussions of space resource activities.

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies<sup>39</sup>, or the Moon Agreement, largely mirrors the Outer Space Treaty, however the provisions of Article 11 develop, or attempt to develop, law on space resources and therefore warrants consideration. That said, the Moon Agreement only has only been ratified by 18 States<sup>40</sup> which has lead to it being regarded as a ‘failed’ treaty<sup>41</sup>, although it is an active treaty and binding on those states that are parties to it. Much of Article 11<sup>42</sup> attempts to elaborate on the prohibition of national appropriation contained in Article II of the Outer Space Treaty. The first section of Article 11 declares that “the Moon and its natural resources are the common heritage of [hu]mankind.”<sup>43</sup> There is no explanation of what exactly this means. “Common heritage” is usually taken to be a stronger, more communal statement than the “province of all [hu]mankind” found in the Outer Space Treaty.<sup>44</sup> However, it is a phrase which remains open to interpretation.

---

<sup>36</sup> *Id.*

<sup>37</sup> COSPAR ‘COSPAR’s Planetary Protection Policy’ [https://cosparhq.cnes.fr/sites/default/files/pppolicydecember\\_2017.pdf](https://cosparhq.cnes.fr/sites/default/files/pppolicydecember_2017.pdf) - Planetary protection principles are designed to prevent ‘forward contamination’ of celestial bodies with Earth organisms.

<sup>38</sup> The International Telecommunications Union (ITU) is a specialised UN agency which, among other things, coordinates the use of radio frequencies in outer space in order to avoid interference with communications with and operation of space objects. See, Tanja Masson-Zwaan, ‘The International Framework for Space Activities’ in Christopher D. Johnson *Handbook for New Actors In Space* (Secure World Foundation 2017), 17-21

<sup>39</sup> Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (adopted 18 December 1979, entered into force 11 July 1984) 1363 UNTS 3 (Moon Agreement)

<sup>40</sup> UNCOPUOS ‘Status of International Agreements Relating to Activities in Outer Space as at 1 January 2019’ (1 April 2019) UN Doc A/AC.105/C.2/2019/CRP.3

<sup>41</sup> Steven Freeland, ‘The Role of ‘Soft Law’ in Public International Law and its Relevance to the International Legal Regulation of Outer Space’ in Irmgard Marboe (eds), *Soft Law in Outer Space: The Function of Non-binding Norms in International Space Law* (Boehlau Verlag, 2012), 9-30, 17-18; Glenn H. Reynolds and Robert P. Merges, *Outer Space: Problems of Law and Policy* (2<sup>nd</sup> edn. Westview 1997), 116

<sup>42</sup> Moon Agreement *supra* note 17, art. 11.

<sup>43</sup> *Id.*

<sup>44</sup> Stephan Hobe ‘Article 1’ in Stephan Hobe, Bernhard Schmidt-Tedd and Kai-Uwe Schrogl eds., *Cologne Commentary on Space Law*, vol 1 (1st edn, Carl Heymanns Verlag, 2009), 27-29; Dr. Ram Jakhu, Freeland, Hobe and Tronchetti ‘Article 11 (Common Heritage of Mankind/International Regime) in Stephan Hobe, Bernhard Schmidt-Tedd, Kai-Uwe Schrogl and Peter Stubbe eds., *Cologne Commentary on Space Law*, vol 2 (1st edn, Carl Heymanns Verlag, 2013), 392-395; Fabio Tronchetti *Fundamentals of Space Law and Policy* (Springer 2013) 13-14; Yoshifumi Tanaka *The International Law of the Sea* (2<sup>nd</sup> edn. Cambridge University Press 2015), 16-19; Frans von der Dunk, ‘International Space Law’ in Frans von der Dunk and Fabio Tronchetti eds., *Handbook of Space Law* (Edward Elgar, 2015), 57-58

Section 5 of Article 11 calls for the establishment of an international regime to govern the “exploitation of the natural resources of the Moon as such exploitation is about to become feasible.”<sup>45</sup> Granted, it does specify the Moon, but there is no reason the international regime could not be extended to cover all celestial bodies. Section 6 calls for State Parties to inform the United Nations Secretary General and the international scientific community of any resources they discover.<sup>46</sup> This could have implications for commercial confidentiality. Nevertheless, terrestrial resource extraction will necessarily involve disclosure of the proposed site of operations so steps can be taken to protect the rights of the discoverer.

Section 7(d) calls for an equitable sharing of the benefits of the resources of the Moon.<sup>47</sup> This is one of the features that causes much of the opposition to the Moon Agreement,<sup>48</sup> however it is worth noting that equitable does not mean equal, it essentially means fair. In total, Article 11 of the Moon Agreement would provide a mechanism for providing legal certainty vis-a-vis space resources.

Even so, it is worth bearing in mind, especially as it remains relevant for those States that are parties to the Moon Agreement. State Parties to the Moon Agreement have an obligation to establish an international regime when space resource activities become feasible, which could potentially have implications for the unity of space law which will be discussed further below (and is another reason why despite the “failure” of the Moon Agreement it cannot simply be ignored.)

## ■ NATIONAL SPACE RESOURCE UTILIZATION LEGISLATION

### A. The United States

The U.S. Space Resource Act<sup>49</sup> was enacted to enable the U.S. to develop a framework for regulating space resource activities.<sup>50</sup> The U.S. Space Resources Act declares that US citizens or entities

“engaged in commercial recovery of an asteroid resource or a space resource... shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, including the international obligations of the United States.”<sup>51</sup>

---

<sup>45</sup> Moon Agreement *supra* note 17, art. 11.

<sup>46</sup> *Id.*

<sup>47</sup> *Id.*

<sup>48</sup> Peter Malanczuk, *Akehurst's Modern Introduction to International Law* (7<sup>th</sup> edn, Routledge 1997), 206; Glenn H. Reynolds and Robert P. Merges, *Outer Space: Problems of Law and Policy* (2<sup>nd</sup> edn. Westview 1997), 114

<sup>49</sup> See U.S. Space Resource Act, *supra* note 2.

<sup>50</sup> Committee on Science, Space and Technology, US House of Representatives ‘Report together with Minority Views on Spurring Private Aerospace Competitiveness and Entrepreneurship Act of 2015’ (Report 114-119, 2015) <https://www.congress.gov/114/crpt/hrpt119/CRPT-114hrpt119.pdf> page 9

<sup>51</sup> U.S. Space Resource Act, *supra* note 2, §51303



It also provides definitions for the term asteroid resource which “means a space resource found on or within a single asteroid.”<sup>52</sup> As well as ‘space resource’ which is “an abiotic resource in situ in outer space.”<sup>53</sup> This includes water and minerals.<sup>54</sup>

The legislation should be seen as an illustration of the U.S. understanding of its obligations to “authorise and supervise” the activities of its nationals in outer space as stipulated by Article VI of the Outer Space Treaty. The U.S. Act has provoked controversy<sup>55</sup> as it arguably conflicts with Article II of the Outer Space Treaty which prohibits national appropriation of outer space, the Moon, and any other celestial body by “claim of sovereignty, by means of use or occupation, or by any other means.”<sup>56</sup> The conflict argument essentially avers that under the U.S. Act the U.S. grants itself the right to grant property rights over space resources to U.S. companies. As such, the legislation could be seen as an attempt by the U.S. to claim jurisdiction over space resources, and by extension, the bodies they are found in.<sup>57</sup>

The U.S. Act does require the “accordance with the international obligations of the United States”<sup>58</sup> and makes the disclaimer that “the United States does not thereby assert sovereignty or sovereign or exclusive rights or jurisdiction over, or the ownership of, any celestial body.”<sup>59</sup> However, some legal scholars, including Fabio Tronchetti, are skeptical of the value of such assurances claiming that:

references to “consistency with international obligations” are vaguely phrased and such a consistency is to be evaluated from a national, US, perspective, which may not be shared, or agreed to, by other States Parties to the UN space treaties.<sup>60</sup>

There is also an issue regarding enforcement. The U.S. Act only applies to citizens of the U.S. or U.S. companies, and clarifies that it is not intended to extend U.S. jurisdiction to any celestial body.<sup>61</sup> Ownership of space resources against foreign nationals or corporations may prove challenging -- especially if such States were to take the view that the act is an illegitimate act of U.S. unilateralism in space, a view which has been expressed at UNCOPUOS<sup>62</sup> – as the Act explicitly narrows its scope to persons under US jurisdiction.<sup>63</sup> This reduces the effectiveness of the act considerably. Enforceability issues are further complicated

---

<sup>52</sup>U.S. Space Resource Act, *supra* note 2, §51301(1)

<sup>53</sup>U.S. Space Resource Act, *supra* note 2, §51301(2)(a)

<sup>54</sup>U.S. Space Resource Act, *supra* note 2, §51301(2)(b)

<sup>55</sup>Gbenga Oduntan 'Who Owns Space? US Asteroid-Mining Act is Dangerous and Potentially Illegal' The Conversation (25 November 2015) Available at: <https://theconversation.com/who-owns-space-us-asteroid-mining-act-is-dangerous-and-potentially-illegal-51073>; 'US Space-Mining Law Seen Leading to Possible Treaty Violations' CBC News (26 November 2015) Available at: <http://www.cbc.ca/news/technology/space-mining-us-treaty-1.3339104>; Russian Delegation, Statement at UNCOPUOS Legal Subcommittee, 4 April 2016 0952-0955 GMT; Russian Delegation, Statement at UNCOPUOS Legal Subcommittee, 5 April 2016 1004-1014 GMT; Belgian Delegation, Statement at UNCOPUOS Legal Subcommittee, 5 April 2016 0906-0908 GMT; Belgian Delegation, Statement at UNCOPUOS Legal Subcommittee, 5 April 2016 0928-0929 GMT

<sup>56</sup> Outer Space Treaty, *supra* note 3, at art. II.

<sup>57</sup>Fabio Tronchetti, *The Space Resource Exploration and Utilization Act: A Move Forward or a Step Back?*, 34 SPACE POLICY 6, 8 (2015).

<sup>58</sup>U.S. Space Resource Act, *supra* note 2, § 51302(a)(2) and (a)(3).

<sup>59</sup>*Id.* at § 403

<sup>60</sup>Tronchetti, *supra* note 51, at 7.

<sup>61</sup>U.S. Space Resource Act, *supra* note 2, Sec. 403.

<sup>62</sup>Russian Delegation, UNCOPUOS Legal Subcommittee, 4 April 2016 0952-0955 GMT; Belgian Delegation, UNCOPUOS Legal Subcommittee, 5 April 2016 0906-0908 GMT

<sup>63</sup>U.S. Space Resource Act, *supra* note 2, Sec. 403.

by the lack of any dispute resolution mechanisms specifically in the Outer Space Treaty<sup>64</sup> at least beyond the existing international institutions such as the International Court of Justice. However the strength of these mechanism is reasonably questionable, particularly as the international rules based comes under increasing threat. China rejected the outcome of the South China Sea case<sup>65</sup> and Britain looks set to do the same regarding the Chagos Islands.<sup>66</sup> As will be discussed in further detail below, enforcement is key to the effectiveness of a property rights regime, so this may be a particular problem, especially if the “national” approach is the dominant model taken to regulating space resource activities.

Nevertheless, national legislation is necessary, as part of the Article VI obligation to “authorise and supervise,” and therefore pointing out these inadequacies is not an attack on national legislation in and of itself but rather an argument for embedding national legislation in some sort of international framework to, at the very least, ensure mutual recognition, facilitate cooperation and the avoid harmful interference. Furthermore, the development of national legislation allows for experimentation in the regulation of space resource activities and the development of a property rights regime, which is important given the novelty of space resource activities. As such, it is premature to expect uniformity. While the second national legislation on space resource activities is in principle similar to that of the U.S., Luxembourg has nevertheless provided the world with a second “model” for space resource legislation.

## B. Luxembourg

Luxembourg’s Law on the Exploration and Use of Space Resources (“Luxembourg Space Resource Law” or the “Luxembourg Law”) came into effect on August 1, 2017.<sup>67</sup> The country first published a draft version of this law in November 2016.<sup>68</sup> Luxembourg has embraced space resource activities from an economic standpoint, as in addition to this law they have also invested over 200 million Euros in the industry.<sup>69</sup>

Article I declares that “space resources are capable of being appropriated.”<sup>70</sup> Although it is notable that unlike its U.S. counterpart,<sup>71</sup> the Luxembourg Space Resource Law does not provide a definition of space resources. However, the explanatory document published with the initial draft of the Luxembourg Law took the definition established in the U.S. Act to be

<sup>64</sup>Fabio Tronchetti *Fundamentals of Space Law and Policy* (Springer 2013), 47-50; Stewart Patrick (2014) ‘The Unruly World: The Case for Good Enough Global Governance’ 93 Foreign Affairs 58, 70

<sup>65</sup><https://www.theguardian.com/world/2016/jul/12/philippines-wins-south-china-sea-case-against-china>

<sup>66</sup><https://www.theguardian.com/world/2019/may/01/corbyn-condemns-mays-defiance-of-chagos-islands-ruling>

<sup>67</sup>Loi 674 du 20 juillet 2017 sur l’exploration et l’utilisation des ressources de l’espace [Law 674 of July 20, 2017 on the Exploration and Use of Space Resources], JOURNAL OFFICIEL DU GRAND-DUCHE DE LUX., July 28, 2017, <http://legilux.public.lu/eli/eta1/leg/loi/2017/07/20/a674/jo> [https://perma.cc/6XX4-KCCE][hereinafter Luxembourg Space Resource Law]; <https://spaceresources.public.lu/en/actualites/2017/Luxembourg-is-the-first-European-nation-to-offer-a-legal-framework-for-space-resources-utilization.html>

<sup>68</sup>[https://gouvernement.lu/dam-assets/fr/actualites/communiqués/2016/11-novembre/11-presentation-spaceresources/Draft-law-space\\_press.pdf](https://gouvernement.lu/dam-assets/fr/actualites/communiqués/2016/11-novembre/11-presentation-spaceresources/Draft-law-space_press.pdf)

<sup>69</sup>See Sarah Scoles, *Luxembourg’s Bid to Become the Silicon Valley of Space Mining*, WIRED (Oct. 1, 2017), <https://www.wired.com/2017/01/luxembourg-setting-silicon-valley-space-mining/>; David Z. Morris, *Luxembourg to Invest \$227 Million in Asteroid Mining*, FORTUNE (June 5, 2016), <https://fortune.com/2016/06/05/luxembourg-asteroid-mining/>.

<sup>70</sup>Loi 674 du 20 juillet 2017 sur l’exploration et l’utilisation des ressources de l’espace [Law 674 of July 20, 2017 on the Exploration and Use of Space Resources], JOURNAL OFFICIEL DU GRAND-DUCHE DE LUX., July 28, 2017, <http://legilux.public.lu/eli/eta1/leg/loi/2017/07/20/a674/jo> [https://perma.cc/6XX4-KCCE][hereinafter Luxembourg Space Resource Law]; <https://spaceresources.public.lu/en/actualites/2017/Luxembourg-is-the-first-European-nation-to-offer-a-legal-framework-for-space-resources-utilization.html>

<sup>71</sup>U.S. Space Resource Act, *supra* note 2, §51301(1),(2)

the “common definition.”<sup>72</sup> This definition is that a space resource is an abiotic resource that can be found in situ in outer space including water and minerals.<sup>73</sup> It is worth noting that this is the definition adopted by the Hague Working Group’s Draft Building Blocks for an International Framework on Space Resources.<sup>74</sup> The U.S. Act also uses the term “asteroid resource,” but the definition of that, as yet, is no different from space resource except for the fact that an asteroid resource is found in an asteroid.<sup>75</sup>

Luxembourg’s Space Resources Law lays out a licencing process for prospective space resource companies to receive approval from the Luxembourg government. The license itself can only be granted to legal persons (i.e. companies) having its registered office in Luxembourg.<sup>76</sup> A license is non-transferable<sup>77</sup> and needs to be used within 36 months of being granted<sup>78</sup> (presumably this just means operations need to have started within 36 months). Furthermore, in order to obtain a license, the applicant must demonstrate, among other things, a “robust scheme of financial, technical, and statutory procedures...” and plans for the exploration, utilization and commercialization phases of operations.<sup>79</sup> Key sections of the Luxembourg Law are backed up by criminal penalties, which range from fines of varying degrees and can include a prison term of between eight days and five years depending on which sections of the Law have been infringed.<sup>80</sup>

When the U.S. Act was enacted in November 2015 it caused quite a stir. There were a number of commentators who declared it to be incompatible with the U.S.” international

---

<sup>72</sup>[https://gouvernement.lu/dam-assets/fr/actualites/communiqués/2016/11-novembre/11-presentation-spaceresources/Draft-law-space\\_press.pdf](https://gouvernement.lu/dam-assets/fr/actualites/communiqués/2016/11-novembre/11-presentation-spaceresources/Draft-law-space_press.pdf), 1; See also US Space Resources Act §51301(1) and (2) as well as The Hague Space Resources Governance Working Group (2017) “Draft Building Blocks for the Development of an International Framework on Space Resource Activities” Available at: <https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimte-recht/space-resources/draft-building-blocks.pdf> Building Block 2.1

<sup>73</sup>[https://gouvernement.lu/dam-assets/fr/actualites/communiqués/2016/11-novembre/11-presentation-spaceresources/Draft-law-space\\_press.pdf](https://gouvernement.lu/dam-assets/fr/actualites/communiqués/2016/11-novembre/11-presentation-spaceresources/Draft-law-space_press.pdf), 1

<sup>74</sup>The Hague Space Resources Governance Working Group (2017) “Draft Building Blocks for the Development of an International Framework on Space Resource Activities” Available at: <https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimte-recht/space-resources/draft-building-blocks.pdf>

<sup>75</sup>US Space Resources Act §51301(1) and (2)

<sup>76</sup>Loi 674 du 20 juillet 2017 sur l’exploration et l’utilisation des ressources de l’espace [Law 674 of July 20, 2017 on the Exploration and Use of Space Resources], JOURNAL OFFICIEL DU GRAND-DUCHE DE LUX., July 28, 2017, <http://legilux.public.lu/eli/eta1/leg/loi/2017/07/20/a674/jo> [https://perma.cc/6XX4-KCCE][hereinafter Luxembourg Space Resource Law], Article 4

<sup>77</sup>Loi 674 du 20 juillet 2017 sur l’exploration et l’utilisation des ressources de l’espace [Law 674 of July 20, 2017 on the Exploration and Use of Space Resources], JOURNAL OFFICIEL DU GRAND-DUCHE DE LUX., July 28, 2017, <http://legilux.public.lu/eli/eta1/leg/loi/2017/07/20/a674/jo> [https://perma.cc/6XX4-KCCE][hereinafter Luxembourg Space Resource Law], Article 5

<sup>78</sup>Loi 674 du 20 juillet 2017 sur l’exploration et l’utilisation des ressources de l’espace [Law 674 of July 20, 2017 on the Exploration and Use of Space Resources], JOURNAL OFFICIEL DU GRAND-DUCHE DE LUX., July 28, 2017, <http://legilux.public.lu/eli/eta1/leg/loi/2017/07/20/a674/jo> [https://perma.cc/6XX4-KCCE][hereinafter Luxembourg Space Resource Law], Article 14(2)

<sup>79</sup>Loi 674 du 20 juillet 2017 sur l’exploration et l’utilisation des ressources de l’espace [Law 674 of July 20, 2017 on the Exploration and Use of Space Resources], JOURNAL OFFICIEL DU GRAND-DUCHE DE LUX., July 28, 2017, <http://legilux.public.lu/eli/eta1/leg/loi/2017/07/20/a674/jo> [https://perma.cc/6XX4-KCCE][hereinafter Luxembourg Space Resource Law], Article 7-10

<sup>80</sup>Loi 674 du 20 juillet 2017 sur l’exploration et l’utilisation des ressources de l’espace [Law 674 of July 20, 2017 on the Exploration and Use of Space Resources], JOURNAL OFFICIEL DU GRAND-DUCHE DE LUX., July 28, 2017, <http://legilux.public.lu/eli/eta1/leg/loi/2017/07/20/a674/jo> [https://perma.cc/6XX4-KCCE][hereinafter Luxembourg Space Resource Law], Article 18

obligations, arising primarily from the Article II of Outer Space Treaty.<sup>81</sup> At the Legal Subcommittee of COPUOS in 2016 and again in 2017 a number of states expressed their concern about the unilateral nature of the US law.<sup>82</sup> There has not been the same degree of reaction to Luxembourg's space resource activities law. There are presumably two reasons for this: one, it is not unprecedented any more; and two, Luxembourg naturally attracts less notice than the United States. That a second state has joined the United States in enacting legislation regulating space resource activities certainly strengthens the case that it is a valid interpretation of the Outer Space Treaty (as the International Institute of Space Law asserted in a position paper released by their board),<sup>83</sup> yet the international legal situation is still developing and will presumably continue to do so for some time yet.

## INTERNATIONAL RESPONSE

### A. UNCOPUOS

UNCOPUOS is the United Nation body primarily responsible for space governance. It has been active since 1959 in one form or another. There are two subcommittees, the Scientific and Technical Subcommittee and the Legal Subcommittee which report to the full Committee which itself reports to the Fourth Committee of the UN General Assembly.<sup>84</sup> UNCOPUOS has been the source of all five space law treaties, as well as a host of resolutions.

Space resource utilization was on the agenda for the Legal Subcommittee in 2018<sup>85</sup> and 2017<sup>86</sup>, although it was also previously discussed at the 2016 session in the wake of the US space resource activities legislation.<sup>87</sup> As should probably be expected space resource activities were a popular and controversial topic at UNCOPUOS. There was quite a bit of concern expressed by a number of states at the "unilateral" nature of the U.S. Act,<sup>88</sup> and Luxembourg's, then proposed, space resource activities law.<sup>89</sup> The concerned States voiced the view that space resource activities either can only or should be authorised by a multilateral international legal regime.<sup>90</sup> The US and Luxembourg contended that they were merely upholding their

---

<sup>81</sup>See Gbenga Oduntan, *Who Owns Space? US Asteroid-Mining Act is Dangerous and Potentially Illegal*, THE CONVERSATION (Nov. 25, 2015), <https://theconversation.com/who-owns-space-us-asteroid-mining-act-is-dangerous-and-potentially-illegal-51073>; *US Space-Mining Law Seen Leading to Possible Treaty Violations*, CBC NEWS (Nov. 26, 2015), <http://www.cbc.ca/news/technology/space-mining-us-treaty-1.3339104>.

<sup>82</sup>UNCOPUOS, "Report of the Legal Subcommittee on its Fifty-Sixth session" (Vienna 18 April 2017) UN Doc A/AC.105/1122, 31-33; UNCOPUOS, "Report of the Legal Subcommittee on its Fifty-Fifth session" (Vienna 27 April 2016) UN Doc A/AC.105/1113, 13

<sup>83</sup>International Institute of Space Law (2015) Position Paper on Space Mining Available at: <http://www.iislweb.org/docs/SpaceResourceMining.pdf> (Accessed 28 January 2017)

<sup>84</sup><http://www.unoosa.org/oosa/en/ourwork/copuos/comm-subcomms.html>; <https://www.un.org/en/ga/fourth/>

<sup>85</sup>A/AC.105/C.2/L.303, item 15

<sup>86</sup>A/AC.105/C.2/L.299, item 14

<sup>87</sup>A/AC.105/1113, 13-14

<sup>88</sup>A/AC.105/1113, para 74-75, page 13

<sup>89</sup>A/AC.105/1113, para 74-75, page 13

<sup>90</sup>Belgian Delegation – UNCOPUOS Legal Subcommittee – 28 March 2017 1421-1429 (GMT); Chinese Delegation – UNCOPUOS Legal Subcommittee – 28 March 2017 932-946 GMT; German Delegation – UNCOPUOS Legal Subcommittee – 29 March 2017 823-906 GMT; Austria – UNCOPUOS Legal Subcommittee – 29 March 906-910 GMT; France – UNCOPUOS Legal Subcommittee -28 March 2017 1429-1432 GMT; Austria - UNCOPUOS Legal Subcommittee - 13 April 2018 858-903 GMT; China - UNCOPUOS Legal Subcommittee - 13 April 2018 1340-1347 GMT; China - UNCOPUOS Legal Subcommittee - 5 April



obligations under Article VI of the Outer Space Treaty to “authorise and supervise” space activities conducted by their nationals and that the widely permissive nature of the Outer Space Treaty allows for space resource activities.<sup>91</sup> There was also considerable discussion of what exactly constitutes national appropriation and whether you can separate a resource from the celestial body it is found in.<sup>92</sup> This discussion was aided by, and to some degree took place during, the European Centre for Space Law/International Institute of Space Law (ECSL/IISL) symposium that took place on the afternoon the of the first Monday during the session.<sup>93</sup>

Beyond the legal questions of space resource activities there were also concerns about the equity of it. Developing states in particular are concerned that once again they will miss out on a mineral “bonanza” that will only exacerbate the divide between developed and developing states.<sup>94</sup> Discussion of this topic centres on the notion that space, and its resources, is a global common interest that belongs to all of humanity, or in the language of the outer space treaty, that space is the “province of all mankind” and should be used in the interest and for the benefit of all States.<sup>95</sup> However, there is, and has been for some time, growing acceptance that the meaning of “for the benefit” and “in the interests” of all and the phrase “province of all mankind” which are included in the Outer Space Treaty, can have broader, less concrete meanings.

One thing that has developed over the past several years of discussions at UNCOPUOS is a growing acceptance, although perhaps not yet consensus, that space resource activities are permitted under international space law.<sup>96</sup> Granted, there are still debates as to how to authorise space resource activities, and whether national legislation under existing international law is sufficient. Nevertheless, the principle that space resource activities is a permitted “use” of outer space, albeit subject to the provisions of Article II of the Outer Space Treaty and the rest of international space law, has gained considerable ground.

---

2019 853-856 GMT; France - UNCOPUOS Legal Subcommittee - 5 April 2019 902-903 GMT; Austria - UNCOPUOS Legal Subcommittee - 8 April 2019 843-846 GMT; Germany - UNCOPUOS Legal Subcommittee - 5 April 2019 829-833 GMT

<sup>91</sup>US Delegation, UNCOPUOS Legal Subcommittee, 5 April 2016 1116-1123; Luxembourg – UNCOPUOS Legal Subcommittee – 28 March 2017 1416-1420 GMT; US Delegation – UNCOPUOS Legal Subcommittee – 28 March 2017 855-903 GMT; US Delegation – UNCOPUOS Legal Subcommittee – 28 March 2017 1433-1441 GMT; US Delegation – UNCOPUOS Legal Subcommittee – 29 March 2017 923-925 GMT; Luxembourg – UNCOPUOS Legal Subcommittee – 10 April 2018 1343-1344; Luxembourg – UNCOPUOS Legal Subcommittee – 13 April 2018 906-912; United States – UNCOPUOS Legal Subcommittee – 10 April 2018 1328-1329; United States – UNCOPUOS Legal Subcommittee – 13 April 2018 1336-1337; Luxembourg – UNCOPUOS Legal Subcommittee – 5 April 2019 1347-1351

<sup>92</sup>Belgian Delegation, UNCOPUOS Legal Subcommittee, 5 April 2016 1028-1029; German Delegation – UNCOPUOS Legal Subcommittee – 29 March 2017 823-906 GMT; Austria – UNCOPUOS Legal Subcommittee – 29 March 2017 906-910 GMT; US Delegation – UNCOPUOS Legal Subcommittee – 28 March 2017 1433-1441 GMT; Germany – UNCOPUOS Legal Subcommittee – 13 April 2018 853-854 GMT; Austria 13 April 2018 858-903; Colombia – UNCOPUOS Legal Subcommittee – 5 April 2019 1344-1345

<sup>93</sup>See <http://www.unoosa.org/oosa/en/ourwork/copuos/lsc/2017/symposium.html>

<sup>94</sup>Chinese Delegation – UNCOPUOS Legal Subcommittee – 28 March 2017 932-946 GMT; Sudan Delegation – UNCOPUOS Legal Subcommittee – 28 March 2017 1347-1350 GMT; Morocco Delegation – UNCOPUOS Legal Subcommittee – 29 March 2017 1420-1421 GMT; Cuba Delegation – UNCOPUOS Legal Subcommittee – 31 March 2017 837-838 GMT; Group of 77 and China – UNCOPUOS Legal Subcommittee – 13 April 2018 841-842 GMT

<sup>95</sup>Chinese Delegation – UNCOPUOS Legal Subcommittee – 28 March 2017 932-946 GMT; Sudan Delegation – UNCOPUOS Legal Subcommittee – 28 March 2017 1347-1350 GMT; Morocco Delegation – UNCOPUOS Legal Subcommittee – 29 March 2017 1420-1421 GMT; Cuba Delegation – UNCOPUOS Legal Subcommittee – 31 March 2017 837-838 GMT; Group of 77 and China – UNCOPUOS Legal Subcommittee – 13 April 2018 841-842 GMT

<sup>96</sup>UN Doc A/AC.105/1203, 32-36; UN Doc A/AC.105/1177, 29-33; UN Doc A/AC.105/1122, 30-33; UN Doc A/AC.105/1113, 13-14

## B. The Hague International Space Resources Governance Working Group

The Hague Working Group was formed in response to the developments in the field of space resource utilization. There was a recognition that “in the absence of a clear framework to govern these activities, there is a need to examine the concepts that are being discussed...”<sup>97</sup> The Hague Working Group released their Draft Building Blocks for the Development of an International Framework on Space Resource Activities (the “Building Blocks”) in September 2017 and continues to work on them.<sup>98</sup>

The Working Group has adopted the same definition of space resource as is found in the U.S. Act and was used in the explanatory document that accompanied the Luxembourg Law. This demonstrates a growing acceptance of a “standard” definition of a space resource as an abiotic resource *in situ* in outer space. The primary concern of the draft building blocks is promotion of “international cooperation and multi-stakeholder dialogue.”<sup>99</sup> The Building Blocks focus on key principles or attributes that any international framework should consider, without taking any view as to the particularities of the framework itself. The Hague Working Group has not been established or authorised by UNCOPUOS but is formed of a group of experts, industry partners and other stakeholders with an interest in promoting the development of an international framework on space resource activities.<sup>100</sup> Rather than delve into detail of the specific building blocks here reference will be made to relevant elements when suitable.

## ■ A GOLD RUSH IN SPACE?

An initial survey of the resources of the solar system makes a compelling case for space mining, or extra-terrestrial resource utilization. It is clear that there are substantial quantities of precious, valuable, and useful metals in asteroids as well as abundant quantities of water, mostly in the form of ice, on asteroids, comets, planets, and moons. For example, it has been suggested that Amun, a fairly small Near-Earth Object (“NEO”) with a mass of approximately 30 billion tons, contains approximately \$8,000 billion in iron and nickel, \$6,000 billion in cobalt and \$8,000 billion in platinum group metals.<sup>101</sup> Similar estimates have projected that the asteroid belt also contains about four billion tons of uranium.<sup>102</sup> Whilst the Moon and other planets may have even more lucrative resources, asteroids, and in particular NEOs, have the added lure of being “the most easily reachable bodies within the entire solar system.”<sup>103</sup> There

<sup>97</sup>International Institute of Air and Space Law (2017) ‘The Hague Space Resources Governance Working Group’ Available at: <https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-for-air-space-law/the-hague-space-resources-governance-working-group>

<sup>98</sup>The Hague Space Resources Governance Working Group (2017) ‘Draft Building Blocks for the Development of an International Framework on Space Resource Activities’ Available at: <https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimterecht/space-resources/draft-building-blocks.pdf>

<sup>99</sup>The Hague Space Resources Governance Working Group (2017) ‘Draft Building Blocks for the Development of an International Framework on Space Resource Activities’ Available at: <https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimterecht/space-resources/draft-building-blocks.pdf>, introduction (para 1)

<sup>100</sup>[https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimterecht/space-resources/final-report\\_the-hague-space-resources-governance-working-group-7-6-18.pdf](https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimterecht/space-resources/final-report_the-hague-space-resources-governance-working-group-7-6-18.pdf), 1-5

<sup>101</sup> JOHN S. LEWIS, MINING THE SKY: UNTOLD RICHES FROM THE ASTEROIDS, COMETS AND PLANETS, 112 (Helix Books, 1997).

<sup>102</sup>*Id.* at 193, 197.

<sup>103</sup>M. DI MARTINO, ET AL., THE ASTEROID HAZARD: EVALUATING AND AVOIDING THE THREAT OF ASTEROID IMPACTS, 195 (1st ed., European Space Agency 2009).



are estimated to be 20,000 NEOs larger than 100m diameter, all capable of being mined in the near future, given sufficient investment.<sup>104</sup>

As well as their relative convenience and abundance of minerals, another aspect of asteroids and NEOs that makes them attractive propositions for resource activity ventures is the potential to utilize water which is present on such bodies.<sup>105</sup> Water is a valuable commodity in space; it can be used for drinking, bathing and cleaning but it can also be used to make air and rocket fuel. As it costs \$20,000 to put a typical 500ml bottle of water into orbit it would be vastly more efficient and cost effective to use a space-based source of water rather than rely on a supply from Earth.<sup>106</sup> Asteroid mining for water ice is technologically feasible and would be achievable using established technology.<sup>107</sup>

The production of fuel in space would be a game changer for the development of the solar system, reducing the cost of access to space dramatically. One industry, on-orbit servicing, is, much like the space resource activities sector, a developing and embryonic industry which would also greatly benefit from a comparatively cheap source of fuel.<sup>108</sup> Additionally, established space companies such as the United Launch Alliance have indicated that they would be willing to pay \$3,000 for a kilogram of propellant delivered to Low Earth Orbit.<sup>109</sup> This projection fits well with the assessment made by John S. Lewis, that payload delivered to Earth orbit for less than \$10,000 per kilogram would be competitive with Earth launched material.<sup>110</sup> In the future, it is not difficult to envisage the creation of a series of space-based filling stations processing locally sourced water and facilitating travel into the solar system.

The Moon is also attracting considerable attention. Moon Express, Inc. (Moon Express) and iSpace, inc. (iSpace) are both companies that are exploring the development of technology capable of exploiting lunar resources.<sup>111</sup> Despite talk of mining the Moon for Helium-3 the main focus, as with asteroids is water ice. This is especially the case if the resources were in support of a manufacturing or servicing industry in low earth orbit, supporting lunar bases and/or a developing cis-lunar economy.<sup>112</sup> At present, such discussions may seem somewhat far-fetched, yet the proposals for a Moon Village from the European Space Agency<sup>113</sup> and commercial “space hotels” from Bigelow Aerospace<sup>114</sup> illustrate that such ideas could soon

---

<sup>104</sup>Martin Elvis, *Prospecting Asteroid Resources in* VIOREL BADESCU, ED., *ASTEROIDS: PROSPECTIVE ENERGY AND MATERIAL RESOURCES*, 81 (Springer 2013).

<sup>105</sup>See JOHN S. LEWIS *ASTEROID MINING 101: WEALTH FOR THE NEW SPACE ECONOMY*, 107-113 (Deep Space Industries 2015); MICHAEL K. SHEPARD *ASTEROIDS: RELICS OF ANCIENT TIME*, 308-9 (Cambridge University Press 2015).

<sup>106</sup>Shepard, *supra* note 93 at 308-9.

<sup>107</sup>John S. Lewis, *Tapping the Waters of Space* 10 SCI. AM. PRESENTS 100, 103 (1999).

<sup>108</sup>Caleb Henry, *Airbus to Challenge SSL, Orbital ATK with New Space Tug Business*, SPACENEWS (Sep. 28, 2017), [https://spacenews.com/airbus-to-challenge-ssl-orbital-atk-with-new-space-tug-business/?utm\\_content=buffer46444&utm\\_medium=social&utm\\_source=twitter.com&utm\\_campaign=buffer](https://spacenews.com/airbus-to-challenge-ssl-orbital-atk-with-new-space-tug-business/?utm_content=buffer46444&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer).

<sup>109</sup>Leonard David, *Inside ULA's Plan to Have 1,000 People Working in Space by 2045*, SPACE.COM (June 29, 2016), <https://www.space.com/33297-satellite-refueling-business-proposal-ula.html>

<sup>110</sup>Lewis, *supra* note 93 at 113.

<sup>111</sup>Chloe Cornish “Interplanetary Players: A Who’s Who of Space Mining” Financial Times (19 October 2017) Available at: <https://www.ft.com/content/fb420788-72d1-11e7-93ff-99f383b09ff9>; Loren Grush, “No One Won the Google Lunar X Prize, but These Competitors are Still Shooting for the Moon” The Verge (31 March 2018) Available at: <https://www.theverge.com/2018/3/31/17176530/google-lunar-x-prize-competition-spaceil-moon-express-astrobotic>

<sup>112</sup>Leonard David, *Is Moon Mining Economically Feasible?*, SPACE.COM (Jan. 7, 2015), <https://www.space.com/28189-moon-mining-economic-feasibility.html>

<sup>113</sup>Jan Woerner *Moon Village: A Vision for Global Cooperation and Space 4.0*, European Space Agency Ministerial Council 2016, available at: [http://m.esa.int/About\\_Us/Ministerial\\_Council\\_2016/Moon\\_Village](http://m.esa.int/About_Us/Ministerial_Council_2016/Moon_Village).

<sup>114</sup>Dinah Eng, *Robert Bigelow is Building Hotels in Space (No, Really)*, FORTUNE (May 19, 2016), <http://fortune.com/2016/05/19/robert-bigelow-hotels-space/>.

emerge as serious propositions. It is even now evident that Mars has “large quantities of nearly pure water ice at the surface of Mars that is concentrated in huge debris-covered glaciers”<sup>115</sup> which would enable the support of surface operations and eventually settlement.

It was this potential bonanza that prompted the formation of Planetary Resources and Deep Space Industries. They announced their intentions to commence commercial asteroid resource activities within the near future in April 2012 and January 2013, respectively.<sup>116</sup> This kicked off the most recent space mining “boom,”<sup>117</sup> however, this was not the first time plans to mine asteroids have been announced, nor is it the first time that it has been suggested that space resource activities are on the verge of becoming a reality. Jim Benson’s SpaceDev announced in the 1990s that it intended to begin commercial asteroid mining; however, nothing ultimately came of that endeavour.<sup>118</sup> Additionally, Fabio Tronchetti asserts that one of the main motivations for the drafting of the Moon Agreement was the concern about the imminent prospect of lunar mining.<sup>119</sup> Suffice it to say no mining of the Moon has yet occurred.

While it is easy to claim that the same failure has happened again, as both Planetary Resources and Deep Space Industries have been acquired by others and have, at the very least, shelved plans for asteroid mining,<sup>120</sup> the U.S. Space Resource Act has changed the playing field. It is no longer particularly relevant whether space resource activities are an imminently viable industry or on the cusp of initiating commercial resource activity operations. As there are now two States with national legislation addressing space resource activities, it is reasonable to expect others to follow. The U.S and Luxembourg laws are likely to serve as templates, in whole or in part, for other national legislation. Furthermore, there is potential for these laws to provoke the development of customary international law regarding space resource activities. Therefore, regardless of the actual viability of the embryonic space resource utilization industry the legal regulation of the industry does need to be discussed. Finally, as noted above, companies like iSpace, among others, continue to actively pursue Lunar resource activities and there are, and may yet be more to come, new entrants to the market, such as UK based Asteroid Mining Corporation Limited.<sup>121</sup> These companies have the stepping stone of an embryonic legal framework which, at the very least, has provided a degree of legitimacy to the notion of space mining. While it is not yet a reality, it has moved, at least in part, out of the realm of science fiction.

### C. Small Solar System Bodies: Asteroids and Comets

---

<sup>115</sup>Fabrizio Bernardini, et al., *Implications for Resource Utilization on Mars - Recent Discoveries and Hypotheses*, 71 J. OF THE BRIT. INTERPLANETARY SOC’Y 186, 188 (2018).

<sup>116</sup>See Alan Boyle, *Big-time Players are Getting Serious about Asteroid Perils and Profits*, NBC NEWS (APR. 16, 2013), [http://cosmiclog.nbcnews.com/\\_news/2013/04/16/17782885-big-time-players-are-getting-serious-about-asteroid-perils-and-profits?lite](http://cosmiclog.nbcnews.com/_news/2013/04/16/17782885-big-time-players-are-getting-serious-about-asteroid-perils-and-profits?lite); Jeff Foust, *Planetary Resources Believes Asteroid Mining Has Come of Age*, THE SPACE REVIEW (Apr. 30, 2012), <http://www.thespacereview.com/article/2074/1>; Paul Rincon, *New Venture “to Mine Asteroids*, BBC NEWS (Jan. 22, 2013), <http://www.bbc.co.uk/news/science-environment-21144769>

<sup>117</sup>See Elizabeth Pearson, *Space Mining: the New Goldrush*, SCIENCE FOCUS (Dec. 11, 2018), <https://www.sciencefocus.com/space/space-mining-the-new-goldrush/>; Morgon Saletta & Kevin Orrman-Rossiter, *All of Humanity Should Share in the Space Mining Boom*, THE CONVERSATION (Apr. 17, 2016), <http://theconversation.com/all-of-humanity-should-share-in-the-space-mining-boom-57740>

<sup>118</sup>See Mark Alpert, *Making Money in Space*, 10 SCI. AM. PRESENTS 92, 95 (1999); Tim Beardsley, *The Way to Go in Space*, 10 SCI. AM. PRESENTS 59, 60-61 (1999).

<sup>119</sup>FABIO TRONCHETTI, THE EXPLOITATION OF NATURAL RESOURCES OF THE MOON AND OTHER CELESTIAL BODIES: A PROPOSAL FOR A LEGAL REGIME, 219 (Martinus Nijhoff, 2009).

<sup>120</sup>Jeff Foust, *The Asteroid Mining Bubble Has Burst*, *supra* note XX.

<sup>121</sup><https://asteroidminingcorporation.co.uk/about-us>

Before delving into the questions of ore, the distribution of resources and the economic viability of extracting it, it is worth considering where exactly this material can be found. Asteroids have received quite a bit of attention these past few years and were the main target for both Deep Space Industry and Planetary Resources.

While asteroids do not appear directly in the Outer Space Treaty, they are subsumed under the general heading “other celestial bodies” (the Moon by contrast is specifically mentioned in the phrase ‘outer space, including the moon and other celestial bodies’ which appears throughout the Outer Space Treaty<sup>122</sup>, though it is this authors reading that this is not intended to distinguish the Moon from other ‘celestial bodies’). It is not within the scope of this paper to explore what the Outer Space Treaty means by “other celestial bodies,” but broadly it means the planets, their moons and ‘small solar systems bodies’, such as asteroids, comets, Trans-Neptunian Objects (TNOs) and other similar bodies<sup>123</sup>(there are those who question whether a “celestial body” as per the Outer Space Treaty needs to be a minimum size<sup>124</sup>, but this is not particularly relevant to the discussion below).

“Small solar system bodies” essentially divide between asteroids and comets,<sup>125</sup> although as will be demonstrated the difference and division between the two is less than absolute. However, as David A. Rothery has written:

Although planetary scientists have come to realize that the boundaries are somewhat blurred, these “junk” objects can be divided into three broad classes: asteroids, Trans-Neptunian objects, and comets.<sup>126</sup>

An asteroid can be defined as “one of the small planetary bodies (also known as minor planets or planetoids) that mainly, but not exclusively, populate the region of the solar system between the orbits of Mars and Jupiter.”<sup>127</sup>

A comet is a small solar system body with a highly eccentric orbit, that goes from periods close to the sun to often far out into the reaches of the solar system.<sup>128</sup> The comets core is generally just a chunk of dusty ice only a few kilometres across.<sup>129</sup>

Beyond Neptune, small icy bodies become common, these objects form what is known as the Kuiper Belt.<sup>130</sup> Together with Scattered Disk<sup>131</sup> objects these make up the TNOs which have a mass “200 times that of the asteroid belt (one-fifth of an Earth-mass), and in total there may be nearly 100,000 bodies more than 100 kilometres in size.”<sup>132</sup> Pluto and Eris are both “Dwarf Planets” and TNOs.<sup>133</sup>

---

<sup>122</sup>See as an example Article II of the Outer Space Treaty which reads “Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.”

<sup>123</sup>Thomas Cheney (2019) *Sovereignty, Jurisdiction, and Property in Outer Space: Space Resources, the Outer Space Treaty, and National Legislation* (PhD thesis in preparation, University of Northumbria), 84-142

<sup>124</sup>Ernst Fasan, ‘Asteroids and other Celestial Bodies – Some Legal Differences’ (1998) 26 J. Space L. 33, 40; Virgiliu Pop, *Who Owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership* (Springer 2009), 53

<sup>125</sup>David A. Rothery *Planets: A Very Short Introduction* (Oxford University Press 2010), 13

<sup>126</sup>DAVID A. ROTHERY PLANETS: A VERY SHORT INTRODUCTION, 13 (Oxford University Press 2010).

<sup>127</sup>M. Di Martino, *supra* note XX, at 303.

<sup>128</sup>Rothery, *supra* note 116, at 15.

<sup>129</sup>Rothery, *supra* note 116, at 15.

<sup>130</sup>Rothery, *supra* note 116, at 14-15.

<sup>131</sup>Rothery, *supra* note 116, at 14-15.

<sup>132</sup>Rothery, *supra* note 116, at 14-15.

<sup>133</sup>Rothery, *supra* note 116, at 14-15.

It is also worth bearing in mind that astronomical terms themselves are vague and “any small sized body orbiting the Sun could be defined as an asteroid.”<sup>134</sup> Furthermore, the core or nuclei of a comet may over time become what would be classified as an asteroid as it is baked and stripped of its icy exterior by the Sun.<sup>135</sup> Indeed, “some near-Earth objects are probably defunct comets with remnant water-ice surviving beneath their dusty surfaces.”<sup>136</sup>

“Asteroids range downwards in size from 950 kilometres across (the diameter of Ceres, the largest example), with no lower limit.”<sup>137</sup> While they were once assumed to be the remains of a destroyed planet they are now thought of as having never been part of a planet and the total mass of all asteroids is calculated at being less than a thousandth of the mass of Earth.<sup>138</sup> Most asteroids orbit in the main belt between Mars and Jupiter, some do come closer towards the Sun and some do orbit beyond Saturn.<sup>139</sup> “Asteroids are not strongly coloured, but can be grouped into several classes according to their reflectance spectrum.”<sup>140</sup>

There are three main types of asteroids: stony, carbonaceous, and metallic; these divide into 24 subtypes of asteroid and 34 subtypes of meteorites.<sup>141</sup> There are several different, overlapping classification systems for asteroids and meteorites, based on different methods of analysis and observation.<sup>142</sup> Asteroid size is determined based on how much sunlight is either absorbed (near-infrared) or reflected (optical)<sup>143</sup> and size only allows us to roughly define an asteroids mass given the variation in asteroid density.<sup>144</sup> Further complication is added by the fact that groups of asteroids such as the Near-Earth Asteroids or Trojans etc are identified not by size or composition but the location of their orbit within the solar system.<sup>145</sup>

A Near Earth Asteroid (NEA) or Near-Earth Object (NEO), again highlighting the ambiguity, is one whose orbit is smaller than 1.3 AU.<sup>146</sup> There are approximately 5000 known NEOs, and their orbital parameters are not constant, NEOs can move over time due to the gravitational influence of other solar system bodies.<sup>147</sup> NEOs are primarily asteroids but there are comets among them. There are 20,000 NEOs larger than 100m diameter and over 10 million larger than 20m diameter. Martin Elvis notes that the data available on NEOs and asteroids more generally is very limited.<sup>148</sup>

---

<sup>134</sup>M. Di Martino, *supra* note XX, at 72.

<sup>135</sup>Lewis, *supra* note XX, at 32; David A. Rothery, *supra* note 116, at 15.

<sup>136</sup>ROTHERY, *supra* note 116 at XX.

<sup>137</sup>*Id.* at 13.

<sup>138</sup>David A. Rothery *Planets: A Very Short Introduction* (Oxford University Press 2010), 13-14

<sup>139</sup>*Id.* at 13-14.

<sup>140</sup>*Id.* at 103.

<sup>141</sup> Martin Elvis, ‘Prospecting Asteroid Resources’ in Viorel Badescu (eds), *Asteroids: Prospective Energy and Material Resources* (Springer 2013), 88-89

<sup>142</sup> Martin Elvis, ‘Prospecting Asteroid Resources’ in Viorel Badescu (eds), *Asteroids: Prospective Energy and Material Resources* (Springer 2013), 88-91

<sup>143</sup>Martin Elvis, ‘Prospecting Asteroid Resources’ in Viorel Badescu (eds), *Asteroids: Prospective Energy and Material Resources* (Springer 2013), 95-96

<sup>144</sup>Martin Elvis, ‘Prospecting Asteroid Resources’ in Viorel Badescu (eds), *Asteroids: Prospective Energy and Material Resources* (Springer 2013), 98

<sup>145</sup>Elvis, *supra* note XX at 88-98.

<sup>146</sup>MICHAEL K. SHEPARD, *ASTEROIDS: RELICS OF ANCIENT TIME* PAGE NUMBER????(Cambridge University Press 2015).

<sup>147</sup>M. Di Martino, *supra* note XX at 190-199.

<sup>148</sup>Martin Elvis, *How Many Ore-Bearing Asteroids?*, 91 *Planetary and Space Science* 20, 20-21 (2014).

Different, overlapping classification systems for asteroids and meteorites, spectrographic tools are not yet sophisticated or accurate enough to form clear picture, not for commercial purposes and certainly not to form the basis of a legal regime. NEOs are categorized by orbit not by size or composition. Asteroid size is determined based on how much sunlight is either absorbed (near-infrared) or reflected (optical). Size only roughly defines mass given variation in asteroid density<sup>149</sup>

#### D. Moon vs Asteroids?

The Moon is also a target for space miners attention, and after the demise of both asteroid mining companies, Deep Space Industries and Planetary Resources, it is probably the most likely place that space resource utilization activities will begin.

First when discussing moons, is the need to differentiate between the Moon and moon(s), the Moon is the one in orbit of the Earth<sup>150</sup> and is specifically mentioned in the Outer Space Treaty.<sup>151</sup> The Moon is a substantial body and, “if the Moon were to orbit the Sun independently there is no doubt that it would be ranked among the “terrestrial planets.”<sup>152</sup> The Moon has been called the Moon for as long as it is possible to trace in Germanic languages.<sup>153</sup>

Moon(s) are “smaller bodies close enough to orbit the planet rather than the Sun.”<sup>154</sup> Or put another way “planets go around the Sun, and moons go around their planets...”<sup>155</sup> However, due to the effect of their planet’s gravity anything in orbit around a moon is inherently unstable therefore no moon has a moon.<sup>156</sup> This section is focused on Earth’s Moon.

One of the major differences between the Moon and asteroids is that there are a considerable number, potentially even millions, of asteroids but Earth has only one Moon. The Outer Space Treaty groups “the Moon into the same category as other celestial bodies.”<sup>157</sup> Therefore it is reasonable to consider whether they should be treated the same, as the Moon is a more finite ‘resource’ perhaps therefore necessitating a stricter process for coordinating access and use. This logically extends to the debate surrounding the resources found within these bodies. Outer space, includes the Moon and other celestial bodies, as per the formulation that finds expression in nearly every article of the Outer Space Treaty, however the drafters of that treaty did debate whether or not to deal with just “outer space” or the “celestial bodies” as well, as is evident from the differing proposed drafts.<sup>158</sup> Even the Moon Agreement, which given its name would seemingly only deal with ‘the Moon’, had its scope broadened to include the other celestial bodies.<sup>159</sup> Furthermore, physical reality (such as differences in size and gravity as well as general accessibility), as well as the distribution of resources on the Moon

---

<sup>149</sup>Martin Elvis, *Prospecting Asteroid Resources*, *supra* note XX at 81-129, 88-98.

<sup>150</sup>David A. Rothery *Moons: A Very Short Introduction* (Oxford University Press 2015), 17

<sup>151</sup>Outer Space Treaty

<sup>152</sup>Rothery, *supra* note XX, at 17.

<sup>153</sup>*Id.*

<sup>154</sup>*Id.*, at 11-12.

<sup>155</sup>*Id.*, at 15.

<sup>156</sup>*Id.*, at 15-16.

<sup>157</sup>Christopher J. Newman, *Seeking Tranquillity: Embedding Sustainability in Lunar Exploration Policy*, 33 SPACE POL’Y 29, 35 (2015).

<sup>158</sup>*See* UNGA Res 1348 (XIII) (13 December 1958); UNGA Res 1472 (XIV) (12 December 1959); UNGA Res 1721 (XVI) (20 December 1961) UN Doc A/A987; UN Doc A/6327; UN Doc A/6341, 1-3; UN Doc A/6352, 1-4; UN Doc A/AC.105/32, 1-6

<sup>159</sup>BIN CHENG, *STUDIES IN INTERNATIONAL SPACE LAW*, 362-3 (Clarendon Press, 1997).

and the existence of some unique attributes such as the so-called “peaks of eternal light”<sup>160</sup> add heft to this consideration. As Christopher Newman has written:

“This conflation of the Moon with other celestial bodies has contaminated all debate and discussion regarding the legal status of the Moon. Policy makers and lawyers need to acknowledge that the Moon is separate from other celestial bodies, and the issues it faces are unique.”<sup>161</sup>

There are two provisions of the Outer Space Treaty that need to be borne in mind. These are the provisions on the avoidance of “harmful contamination” found in Article IX, and the requirements that space be used in the interests and for the benefit of all countries and humanity in Article I. Granted, neither of these aspects of the treaty have been particularly well elaborated but they do and can have consequences.

Article IX is potentially a foundation stone for the creation of an environmental space law. There are a number of aspects that could come into play. First, the potential to contaminate or even destroy sites of scientific interest is a high and very real risk especially given the low level of exploration of the Moon. However, it is also worth noting that lunar resource activities operations can (and most likely will) be done in support of scientific expeditions as well as for purely commercial purposes. Ultimately, in situ resource utilization (“ISRU”) will enable greater and cheaper exploration of the Moon and other celestial bodies. However, there are also sites of historic importance, most notably the Apollo 11 landing site, as well as areas that are of aesthetic value and worth preserving in their own right. In the author’s view, The Hague Working Group’s Draft Building Blocks at least begin to address some of these concerns, but further consideration is needed. There may be similar concerns with regards to some of the more significant asteroids (such as Ceres) but these are mainly issues that will be relevant to the Moon and, later on, the other terrestrial planets and moons.

Article I stipulates that “use” of outer space, the Moon, and other celestial bodies “shall be carried out for the benefit and in the interests of all countries.”<sup>162</sup> There is, once again, no clear meaning as to what this means. The Space Benefits Declaration<sup>163</sup> was an attempt to develop this aspect of the Outer Space Treaty in a General Assembly Resolution.<sup>164</sup> While developing States have tried to argue that this provision requires some sort of technology, benefits and/or profit sharing, since the Space Benefits Declaration understanding has developed away from this a more to broader provision of access to the benefits of space technology as well as general international cooperation in space.<sup>165</sup>

It is apparent that international cooperation has increasingly developed according to the principles laid down in the Declaration on Space Benefits. Despite divergent views on the specific requirements of benefit sharing present during the negotiations of the Declaration and remaining to this day, States still

---

<sup>160</sup>A ‘peak of eternal light’ is a location on the surface of a celestial body that enjoys permanent or near permanent sunlight, see: [https://en.wikipedia.org/wiki/Peak\\_of\\_eternal\\_light](https://en.wikipedia.org/wiki/Peak_of_eternal_light)

<sup>161</sup>Newman, *supra* note XX, at 35.

<sup>162</sup>Outer Space Treaty, Article I

<sup>163</sup>UNGA Res 51/122 (1996)

<sup>164</sup>Elena Carpanelli and Brendan Cohen (2012) “A Legal Assessment of the 1996 Declaration on Space Benefits on the Occasion of its Fifteenth Anniversary” 38 Journal of Space Law 1, 3

<sup>165</sup>Elena Carpanelli and Brendan Cohen (2012) “A Legal Assessment of the 1996 Declaration on Space Benefits on the Occasion of its Fifteenth Anniversary” 38 Journal of Space Law 1, 31-35



provide access to the benefits of space technology, albeit in ways that mirror their understanding of the Declaration.<sup>166</sup>

---

<sup>166</sup>*Ibid*, 35

#### IV. CONSIDERATIONS OF ECONOMIC VIABILITY AND EQUITY

As discussed above, there is an abundance of interesting and useful material in the solar system, from iron, platinum group metals or water, however, the distribution and accessibility of this material is less clear, especially when the economic viability of extraction is considered. One of the concerns about the developments of a space resource activities framework is that it will be based, essentially, on a ‘first come first served’ basis which will, once again, disadvantage developing States as the ‘spacefaring’ States<sup>167</sup> will scoop up the lowest hanging fruit before the developing States have a chance to get in on the action. This would likely exacerbate the inequality between the rich States and the poor States. Given the abundance of resources potentially available in the solar system it may seem that this is not an issue, however this is worth examining.<sup>168</sup>

Ore, as used by the terrestrial mining industry, means commercial profitable material. "Ore is not simply a high concentration of some resource, but includes consideration of the cost of extraction of the resource and its price."<sup>169</sup> Therefore, when talking about the material wealth of the solar system it is not enough to simply talk about the vast quantities of material that is available in the totality of the system but the quantity of ore is what needs to be discussed. Now ore is obviously something of a fluid concept as what constitutes economically viable will change based on technological development as well as the market price of the resource in question.

Martin Elvis claims that focus should be on NEOs because main belt is “too hard to reach”.<sup>170</sup> NEOs are primarily asteroids but there are comets among them.<sup>171</sup> There are 20,000 NEOs larger than 100m diameter and over 10 million larger than 20m diameter.<sup>172</sup> Elvis assessed NEOS for both platinum group metals and water. Elvis notes that the data available on NEOs and asteroids more generally is very limited. He assesses that the range of profitability based on the size of a PGM asteroid is quite vast, asteroids in excess of 100m diameter are most promising for PGM, smaller asteroids rapidly become unpromising targets.<sup>173</sup> "Good size and mass estimates are thus crucial to asteroid mining."<sup>174</sup>

---

<sup>167</sup>‘Spacefaring State’ is a variable term, hence the use of inverted commas. It could apply to those States which have substantial and regular launch capability such as China (People’s Republic of), France, India, Japan, United States. There are other States which have the ability to launch payloads but not necessarily regularly, such as Iran and Israel. There are a wider circle of ‘active’ participants in space, Germany, for example has a robust space programme, the United Kingdom has a significant commercial space industry although neither have an ‘indigenous’ launch capability and are reliant upon the launch vehicles of other States to ‘access’ space. However, broadly in this usage ‘spacefaring’ State is used in the sense of ‘States whose interests are specially affected’ as per *North Sea Continental Shelf* cases, ICJ Reports 1969, p.3, 43, para 74

<sup>168</sup>JOHN S. LEWIS, *MINING THE SKY: UNTOLD RICHES FROM THE ASTEROIDS, COMETS AND PLANETS*, 112 (Helix Books, 1997); M. DI MARTINO, ET AL., *THE ASTEROID HAZARD: EVALUATING AND AVOIDING THE THREAT OF ASTEROID IMPACTS*, 195 (1st ed., European Space Agency 2009).

<sup>169</sup>Martin Elvis, *How Many Ore-Bearing Asteroids?*, 91 *PLANETARY AND SPACE SCIENCE* 20, 20 (2014).

<sup>170</sup>Martin Elvis, *How Many Ore-Bearing Asteroids?*, 91 *PLANETARY AND SPACE SCIENCE* 20, 20 (2014).

<sup>171</sup> Martin Elvis, *How Many Ore-Bearing Asteroids?*, 91 *PLANETARY AND SPACE SCIENCE* 20, 20 (2014).

<sup>172</sup>Martin Elvis, *How Many Ore-Bearing Asteroids?*, 91 *PLANETARY AND SPACE SCIENCE* 20, 20 (2014).

<sup>173</sup>Elvis at 20-23.

<sup>174</sup>Elvis at 23.

Elvis argues that 100m diameter seems like an “optimistic” estimate for a profitability threshold, granted the costs of resource activity missions are yet unknown.<sup>175</sup> And there are about 20,000 NEOs, however he estimates that the number of commercially viable (ore-bearing) NEOs (given costs of mission and getting to and from object etc) is only about 10 (assuming an outbound delta-v of 4.5km/s) though he stresses “that this number has large uncertainties and includes only metallic asteroids. Nonetheless, the number is surely smaller than would-be asteroid miners may have expected.”<sup>176</sup>

Elvis does note that if he allows for a slightly higher outbound delta-v assumption (5.5km/s) then the number of PGM ore-bearing NEOs would rise to about 100.<sup>177</sup> “Water is often considered the first product likely to be mined from space. The water would be used in space either for life support or, separated into hydrogen and oxygen, for rocket fuel.”<sup>178</sup> Smaller NEOs are more viable targets for water miners than PGM.<sup>179</sup> Elvis reckons that there are about 9000 water ore-bearing NEOs for outbound delta-v assumption of 4.5km/s and allowing for the same increase to 5.5km/s that would rise to about 90000.<sup>180</sup> “Clearly improved surveys to find and characterize small NEOs would be extremely helpful in making the profitable mining of asteroids water feasible.”<sup>181</sup> Elvis points out that there are also significant engineering questions that would force an adjustment of the assessment of what would constitute a profitable NEO.<sup>182</sup> Elvis estimates that there are relatively few ore-bearing NEOs. Though water-ore-bearing NEOs will be more plentiful and easier to find.<sup>183</sup> “Initial estimates give very low values for platinum group metals, larger, but still modest, numbers for water.”<sup>184</sup>

That said, understanding of distribution of material has improved due to various broadband sky surveys but our understanding of asteroid composition has not improved all that much. However, with the exception of the largest asteroids, spacecraft surveys will be the only way to determine composition of asteroids,<sup>185</sup> and to date spacecraft have visited 12 asteroids.<sup>186</sup> At least for MAB asteroids their “parent” body was probably hot enough to cause enough internal heating to give rise to differentiation which means that the remaining fragments (today’s asteroids) will have different compositions (including metallic iron from the core).<sup>187</sup>

## ■ DEVELOPING AN INTERNATIONAL REGIME

### A. Do We Need a Space Property Rights Regime?

<sup>175</sup>Martin Elvis, *How Many Ore-Bearing Asteroids?*, 91 PLANETARY AND SPACE SCIENCE 20, 22-23 (2014).

<sup>176</sup>Elvis at 23.

<sup>177</sup>*Id.* at 23.

<sup>178</sup>*Id.* at 23.

<sup>179</sup>*Id.* at 24.

<sup>180</sup>*Id.* at 24.

<sup>181</sup>*Id.* at 24.

<sup>182</sup>*Id.* at 24-25.

<sup>183</sup>*Id.* at 25.

<sup>184</sup>*Id.* at 26.

<sup>185</sup>N.E. Bowles et al., *CASTAway: An Asteroid Main Belt Tour and Survey*, 62 ADVANCES IN SPACE RESEARCH 8, 1998-2025 (2018), 2004-2005

<sup>186</sup>N.E. Bowles et al., *CASTAway: An Asteroid Main Belt Tour and Survey*, 62 ADVANCES IN SPACE RESEARCH 8, 1998-2025 (2018), 2004-2005

<sup>187</sup>N.E. Bowles et al., *CASTAway: An Asteroid Main Belt Tour and Survey*, 62 ADVANCES IN SPACE RESEARCH 8, 1998-2025 (2018), 2004-2005

Some within the space sector have argued that private business needs clear, defined property rights to succeed and that legal stability and certainty is also vital to the health and success of industry.<sup>188</sup> This therefore means that any meaningful investment in space resource activities requires legal certainty and security, which is currently not provided by the existing space law regime. Ricky J. Lee, for example, claims that the process of exploration of celestial bodies and extraction of material would be the aspect of the space resource activities process that would encounter the most legal difficulties (compared with launch etc.) and that the need for exclusivity in resource activity operations may mean it is impossible under the current space law regime.<sup>189</sup> He estimated that a space resource activity venture would require capitalization of 100 billion USD<sup>190</sup> and that “private investment on such a scale can be feasible only with a substantial degree of certainty in the rights to explore, extract and exploit the mineral resources on celestial bodies.”<sup>191</sup> Others have argued that the current space property rights regime is a barrier not just to space resource activities but to commercial development in general. Richard Berkley has written that “the current public law regime in outer space retards private activity in space.”<sup>192</sup> While Yun Zhao has gone so far as to say that the current space law regime “is the primary impediment to the commercial development of outer space.”<sup>193</sup>

Economists and lawyers broadly agree on the necessity of property rights and the rule of law for economic and business success. This position has a long history, Lord Mansfield, in the eighteenth century, argued that commerce needs legal certainty in order to thrive.<sup>194</sup> It is widely acknowledged that economic activity requires as much stability as possible which the rule of law helps to provide<sup>195</sup> and as Lord Bingham has written, “no one would choose to do business, perhaps involving large sums of money in a country where the parties’ rights and obligations were vague or undecided.”<sup>196</sup> Although it is worth noting that not all economists agree that property rights are vital for economic development or agree with the narrative that property rights have been the primary driver of economic development. Thomas Piketty has argued that the diffusion of knowledge and skills has been the primary driver of growth, particularly over the long term.<sup>197</sup> The resource extraction industry, in particular, has demonstrated that strong property rights and the rule of law are not necessarily vital for even

---

<sup>188</sup>See generally, Richard Berkley, *Space Law Versus Space Utilization: The Inhibition of Private Industry in Outer Space*, (1997) 15 WIS. INT’L L.J. 421, 428 (1997); Bryon C. Brittingham, *Does the World Really Need New Space Law?* 12 OR. REV. INT’L L. 31, 34, 47 (2010); FABIO TRONCHETTI, THE EXPLOITATION OF NATURAL RESOURCES OF THE MOON AND OTHER CELESTIAL BODIES: A PROPOSAL FOR A LEGAL REGIME, 225, 237 (Martinus Nijhoff, 2009); MATTHEW J. KLEIMAN, THE LITTLE BOOK OF SPACE LAW, 140 (American Bar Association, 2012); JAMES CLAY MOLTZ, CROWDED ORBITS: CONFLICT AND COOPERATION IN SPACE, 98 (Columbia University Press 2014).

<sup>189</sup>RICKY J. LEE, LAW AND REGULATION OF COMMERCIAL MINING OF MINERALS IN OUTER SPACE, 11, 13-14, 95-6 (Springer 2012).

<sup>190</sup>RICKY J. LEE, LAW AND REGULATION OF COMMERCIAL MINING OF MINERALS IN OUTER SPACE, 11, 13-14, 95-6 (Springer 2012).

<sup>191</sup>*Id.* at 96.

<sup>192</sup>Richard Berkley, *Space Law Versus Space Utilization: The Inhibition of Private Industry in Outer Space*, 15 WIS. INT’L L.J. 421, 422 (1997).

<sup>193</sup>YUN ZHAO, SPACE COMMERCIALIZATION AND THE DEVELOPMENT OF SPACE LAW FROM A CHINESE LEGAL PERSPECTIVE, 5-6 (Nova, 2009).

<sup>194</sup>*Hamilton v. Mendes*, 2 Burr 1198, 1214 (1761); *Vallejo and Another v. Wheeler*, 1 Cowp 143, 153 (1774).

<sup>195</sup>Todd Zywicki, *Economic Uncertainty, the Courts, and the Rule of Law*, 35 HARV. J. L. & PUB POL’Y 195 (2012); “*Economics and the Rule of Law: Order in the Jungle*, THE ECONOMIST, (March 13, 2008) 95; JEREMY WALDRON, THE RULE OF LAW AND THE MEASURE OF PROPERTY, 10-11 (Cambridge University Press 2012); TOM BINGHAM, THE RULE OF LAW, 38 (Penguin: 2011).

<sup>196</sup>BINGHAM, THE RULE OF LAW, *supra* note 185, 38.

<sup>197</sup>THOMAS PIKETTY, CAPITAL IN THE TWENTY-FIRST CENTURY, 20-22, 69-71 (trans. Arthur Goldhammer, Belknap Press, 2014).

large-scale investments; the resource extraction industry often operates in states with insecure property rights and a weak adherence to the rule of law.<sup>198</sup>

While there is certainly a broad consensus regarding the importance of property rights, there is a debate regarding the best way to create a property rights regime. While there are numerous possible approaches there are two that are most relevant to the space resources discussion. The first approach is to develop a ‘top down’ regime in advance of economic development. The other is to allow a regime to develop organically and codify the regime that emerges. Economically, organic development tends to be the most efficient as those who develop the norms have a stake in making it so.<sup>199</sup> However, economic efficiency is not the only aspect to consider.

It is important that property rights are properly defined but it is vital that property rights are properly enforced. Without *effective* enforcement, property rights do not really exist.<sup>200</sup> As Sandra Joireman wrote in her study of property rights in common law Africa, “without the enforcement of laws related to property, or indeed to any other area of legal rights, the law may as well not exist.”<sup>201</sup> Property is an economic and social concept and “the enforcement of property rights is fundamentally political.”<sup>202</sup> Property rights and their enforcement mechanisms are embedded within and dependent upon the political system, they cannot be separated.<sup>203</sup> When constructing a property rights regime, it is therefore vital to consider how those property rights are going to be enforced, and how disputes will be resolved (preferably as quickly and easily as possible.) The importance of enforcement to the effectiveness of a property rights system was demonstrated by the North American beaver trade of the nineteenth century. The US Government passed numerous laws designed to regulate the trade in beavers, partly to conserve supply and partly to avoid unnecessarily antagonizing Native Americans. However, with few US troops west of the Mississippi the US Government was completely incapable of enforcing these regulations and preventing the virtual eradication of the beaver population as a viable source of furs.<sup>204</sup>

Though there is more to this than just the government’s ability to physically enforce the law. Property rights as defined in statute need to be in harmony with the reality on the ground.<sup>205</sup> Joireman found that when the official property rights system does not work or is inefficient (or simply out of reach), an informal system arises in parallel or in replacement of the official system.<sup>206</sup> If the ‘transaction costs’ involved in defining and enforcing property

---

<sup>198</sup>SANDRA F. JOIREMAN, *WHERE THERE IS NO GOVERNMENT: ENFORCING PROPERTY RIGHTS IN COMMON LAW AFRICA*, 108 (Oxford University Press 2011); Howard W. French, *The Plunder of Africa: How Everybody Holds the Continent Back*, 94 FOREIGN AFF. 150 (2015); Larry Diamond and Jack Mosbacher, *Petroleum to the People: Africa’s Coming Resource Curse and How to Avoid It*, 92 FOREIGN AFF. 86 (2013).

<sup>199</sup>Terry L. Anderson and Peter J. Hill, *The Not So Wild West: Property Rights on the Frontier* (Stanford University Press 2004), 7-8

<sup>200</sup>JOIREMAN, *supra* note 192 at 5.

<sup>201</sup>JOIREMAN, *supra* note 192 at 5.

<sup>202</sup>*Id.* at 6.

<sup>203</sup>*Id.* at 7-8.

<sup>204</sup>David J. Wishart, *The Fur Trade of the American West 1807-1840* (University of Nebraska Press, 1979), 31-33, 65-66, 70-71; Terry L. Anderson and Peter J. Hill, *The Not So Wild West: Property Rights on the Frontier* (Stanford University Press 2004), 77-93

<sup>205</sup>Hernando de Soto, *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else* (Black Swan 2001), 111-112

<sup>206</sup>Joireman, Sandra F. *Where There is No Government: Enforcing Property Rights in Common Law Africa* (1<sup>st</sup> edn Oxford University Press 2011), 57-59, 79, 82;

rights are too high then actors will either not bother or will operate outside the official system.<sup>207</sup> Ostrom argues that there is no single solution to this but that the key is getting the ‘institutions’ right.<sup>208</sup> However, this does not necessarily mean a formal institution but can be an informal arrangement.<sup>209</sup> It requires a flexible situation and recognizing that different approaches are necessary for differing situations. For example, the ability to exclude and the nature of the resource are important factors in the ability to develop bottom-up solutions.<sup>210</sup> Furthermore, the nature and makeup of the community involved are important in the success of less formalised models.<sup>211</sup> One of the key messages Ostrom provides is the need to understand the situation before devising a solution<sup>212</sup>, this presents a problem with regards to space resources, as there are many unknowns.

A property rights regime is necessary, property rights are vital to economic development.<sup>213</sup> However, there is more to it than simply creating a law granting property rights to space resources. In order for any property rights over space resources to have value they need to be enforceable. The regime also needs to have the support and acceptance of the community of actors. It is one thing to be able to enforce property rights by force, either through private means or the backing of a States, but it is better to not have to other actors respect your property rights without the ‘transaction costs’ involved in maintaining constant vigilance. In outer space, this means an international regime. As mentioned, this does not necessarily mean the creation of a body akin to the International Seabed Authority, but it does mean the creation of some sort of system for mutual recognition and acceptance. This regime need to be flexible, given the numerous unknowns about space resources and the nature of the industry to extract them, but it is vital that it has international legitimacy, so that it is effective.

## **B. An International Regime for Conflict Prevention**

The Outer Space Treaty celebrates its fiftieth “birthday” this year, the governance regime that it established has served space well. Space has become a vital part of Earth’s infrastructure and economy, which has been made possible by the order and stability provided

---

<sup>207</sup>Terry L. Anderson and Peter J. Hill, *The Not So Wild West: Property Rights on the Frontier* (Stanford University Press 2004), 14

<sup>208</sup>Elinor Ostrom *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge University Press 2015), 14

<sup>209</sup>Elinor Ostrom *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge University Press 2015), 39

<sup>210</sup>Mark Pennington, ‘Elinor Ostrom, Common-pool Resources and the Classical Liberal Tradition’ in Elinor Ostrom, Christina Chang, Mark Pennington and Vlad Tarko, *The Future of the Commons: Beyond Market Failure and Government Regulation* (The Institute of Economic Affairs 2012), 21-47, 26

<sup>211</sup>Mark Pennington, ‘Elinor Ostrom, Common-pool Resources and the Classical Liberal Tradition’ in Elinor Ostrom, Christina Chang, Mark Pennington and Vlad Tarko, *The Future of the Commons: Beyond Market Failure and Government Regulation* (The Institute of Economic Affairs 2012), 21-47, 26-27

<sup>212</sup>Elinor Ostrom ‘The Future of the Commons: Beyond Market Failure and Government Regulation’ in Elinor Ostrom, Christina Chang, Mark Pennington and Vlad Tarko, *The Future of the Commons: Beyond Market Failure and Government Regulation* (The Institute of Economic Affairs 2012), 68-83, 69

<sup>213</sup>Joireman, Sandra F. *Where There is No Government: Enforcing Property Rights in Common Law Africa* (1<sup>st</sup> edn Oxford University Press 2011), 8



by the space law regime which rests upon the Outer Space Treaty.<sup>214</sup> Space resource activities have the potential to undermine the stability of the space law regime. There are three main potential friction points which will be discussed below. The first potential conflict is over the legality of space resource activities themselves, with a second potential area of conflict being over the actual resources being extracted and the third over the distribution of the profits (or benefits) from space resource activities. These three issues have the potential to destabilise or delegitimize the space law regime without which the economic value of space would considerably diminish.

### C. Conflict Over the Legality of Space Mining

The first potential area for conflict or crisis in space law is over the legality of space resource activities themselves. There was a hint of this at the 2016 Legal Subcommittee (LSC) session of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) when several delegations, most notably that of the Russian Federation, strongly objected to and criticised the United States' Space Resource Exploration and Utilization Act of 2015. Criticism focused on the perceived unilateral nature of the US space law.<sup>215</sup> This has not deterred the US or Luxembourg or the other few countries considering space resource activities laws from proceeding. Indeed, as discussed above the general trend is toward accepting that space resource activities are permitted under the freedom of use" found within Article I of the Outer Space Treaty albeit subject to certain restrictions.<sup>216</sup>

However, it is worth considering the counter-arguments the legality of space resource activities and the US and Luxembourg position in particular. There are essentially three arguments. The first is that Article II of the Outer Space Treaty creates a total prohibition on property rights in space and this includes commercial space resource activities operations. The second is that these national laws are an act of sovereignty and are therefore incompatible with the space law regime. The third is that space resource activities can only be legal under an international regime. The counter-argument to this is that it is a valid interpretation of international law and within the rights of states to do this.

If a strict interpretation of the term 'appropriation' is taken then it can be argued that Article II of the Outer Space Treaty prohibits any and all appropriation. Under this line of argument, while a resource can be physically removed from a celestial body it remains legally indistinguishable from the celestial body. In effect you have merely created celestial body 'a' and celestial body 'b'. The portion that you have extracted is no more 'appropriable' than the part that 'remains'. This would mean that commercial space resource activities would be a violation of international space law.<sup>217</sup>

---

<sup>214</sup> JOAN JOHNSON-FREESE, *SPACE WARFARE IN THE 21<sup>ST</sup> CENTURY: ARMING THE HEAVENS*, 145 (Routledge 2017); JAMES CLAY MOLTZ, *CROWDED ORBITS: CONFLICT AND COOPERATION IN SPACE*, 98, 119 (Columbia University Press 2014).

<sup>215</sup> Russian Delegation, UNCOPUOS Legal Subcommittee, 4 April 2016 1052-1055

<sup>216</sup> UN Doc A/AC.105/1203, 32-36; UN Doc A/AC.105/1177, 29-33; UN Doc A/AC.105/1122, 30-33; UN Doc A/AC.105/1113, 13-14

<sup>217</sup> Paul B. Larsen, *Asteroid Legal Regime: Time for a Change?*, 39 J. SPACE L. 275, 277-305 (2014); Bryon C. Brittingham, *Does the World Really Need New Space Law?*, 12 OR. REV. INT'L L. 31, 32-54 (2010); Ricky J. Lee, *Article II of the Outer Space Treaty: Prohibition of State Sovereignty, Private Property Rights or Both?*, 11 AUSTL. INT'L L. J. 128, 128-141 (2004); Ulrike M. Bohlmann, *Legal Aspects of the 'Space Exploration Initiatives'*, in MARIETTA BENKÖ AND KAI-UWE SCHROGL EDS., *SPACE LAW: CURRENT PROBLEMS AND PERSPECTIVE FOR FUTURE REGULATION*, 215-240, 224 (Eleven 2005); Virgiliu Pop, *Appropriation in Outer*

An alternate argument and the one put forth by several States at the 2016 session of the Legal Subcommittee of the UN Committee on the Peaceful Uses of Outer Space is that the US space resource activities law constitutes an act of national appropriation which is incompatible with the Outer Space Treaty.<sup>218</sup> The argument is that authorising resource activities and/or granting title over extracted resources is an act of national appropriation which is in violation of Article II. This is because in order for a government to have the authority to regulate an activity (such as you may mine this area) they need to have jurisdiction over the area the activity is being conducted in which therefore violates Article II of the Outer Space Treaty. Alternatively, the government in question is granting title to the extracted resource and is thus claiming ownership as you cannot transfer ownership of something you do not possess yourself.<sup>219</sup>

A third potential argument is that space resources are part of the ‘global commons’ and therefore require an international regime in order to be legitimately authorised. As the ‘province of all Mankind’ space belongs to the international community, and therefore no individual state has the right to authorise its nationals to conduct resource activities within it, only the international community working together, preferably through the United Nations can sanction space resource activities. This holds even more true for those States who are party to the Moon Agreement, who look towards Article 11 of that treaty.<sup>220</sup>

The counterargument to these three viewpoints, and the one put forth by the United States, Luxembourg, and a few others, is that the view that it is within the purview of states to authorize space resource activities is a legitimate interpretation of the Outer Space Treaty and it is within the rights of a State Party to unilaterally interpret their obligations under a treaty.<sup>221</sup> Both the US and Luxembourg make no claim to territorial sovereignty or control over any celestial body either in whole or in part, or indeed to the resources in situ.<sup>222</sup> They are regulating the activities of their nationals as they are required to do by Article VI of the Outer Space Treaty.<sup>223</sup> Furthermore, the United States rejects the requirement for an international regime as

---

*Space: The Relationship Between Land Ownership and Sovereignty on the Celestial Bodies*, 16 SPACE POL’Y 275, 276-277 (2000).; A/AC.105/1113, page 13, para 74

<sup>218</sup>A/AC.105/1113, page 13, para 74

<sup>219</sup>Fabio Tronchetti, *The Space Resource Exploration and Utilization Act: A Move Forward or a Step Back?*, 34 SPACE POL’Y 6, 7-9 (2015); FRANCIS LYALL AND PAUL B. LARSEN SPACE LAW: A TREATISE, 184-197 (Ashgate 2009); THOMAS GANGALE, THE DEVELOPMENT OF OUTER SPACE: SOVEREIGNTY AND PROPERTY RIGHTS IN INTERNATIONAL SPACE LAW, 9-53 (Praeger, 2009).

<sup>220</sup>Fabio Tronchetti, *The Space Resource Exploration and Utilization Act: A Move Forward or a Step Back?*, 34 SPACE POL’Y 6, 7-9 (2015).

<sup>221</sup>US Delegation, UNCOPUOS Legal Subcommittee, 5 April 2016 1116-1123; Luxembourg Ministry of the Economy (2016) Luxembourg’s New Space Law Guarantees Private Companies the Right to Resources Harvested in Outer Space in Accordance with International Law Available at:

<http://www.gouvernement.lu/6481433/11-presentation-spaceresources>; International Institute of Space Law (2015) Position Paper on Space Mining Available at: <http://www.iislweb.org/docs/SpaceResourceMining.pdf>; ARTHUR M. DULA AND ZHANG ZHENIUN (EDS.) SPACE MINERAL RESOURCES: A GLOBAL ASSESSMENT OF THE CHALLENGES AND OPPORTUNITIES, 302 (International Academy of Astronautics, 2015)

<sup>222</sup>US Commercial Space Launch Competitiveness Act, Title IV, sec. 403: [https://gouvernement.lu/dam-assets/fr/actualites/communiqués/2016/11-novembre/11-presentation-spaceresources/Draft-law-space\\_press.pdf](https://gouvernement.lu/dam-assets/fr/actualites/communiqués/2016/11-novembre/11-presentation-spaceresources/Draft-law-space_press.pdf), 4-5

<sup>223</sup>[https://gouvernement.lu/dam-assets/fr/actualites/communiqués/2016/11-novembre/11-presentation-spaceresources/Draft-law-space\\_press.pdf](https://gouvernement.lu/dam-assets/fr/actualites/communiqués/2016/11-novembre/11-presentation-spaceresources/Draft-law-space_press.pdf), 6; US Delegation – UNCOPUOS Legal Subcommittee – 29 March 2017 923-925 GMT

they are not party to the Moon Agreement and therefore are not bound by it.<sup>224</sup> Luxembourg is also not a party to the Moon Agreement.<sup>225</sup>

If two blocks emerge, one which regards space resource activities as legal and legitimate and another which regards either space resource activities or the legal regime underpinning it as incompatible with international law and/or illegitimate then this has the potential to undermine the space law regime itself. This is particularly a concern if those States engaged in space resource activities feel they need to circumvent the UN centred system. Given the nature of space it needs to be governed by an internationally recognized and respected regime in order to be workable. Therefore, a breakdown in the established space law regime could prove seriously detrimental to the value of the space environment for all actors.

#### **D. Conflict Over Resources**

A second potential source of conflict is over resources themselves. It is quite clear that there is an abundance of resources in the solar system however where those resources are located and how easy they are to access is not as clear. The initial target for space resource activities will likely be the Near-Earth Asteroids (NEOs) as their location makes them relatively easy to access even compared to the Moon.<sup>226</sup> However, there is still a lot we do not know about the distribution of resources among NEOs,<sup>227</sup> as discussed above. If easy to access resource rich asteroids turn out to indeed be a rarity, then that could cause problems

The US and Luxembourg space resource activities laws only apply to their respective nationals. This is not necessarily a problem if the space resource activities industry is restricted to a handful of actors but as ‘informal’ agreement could work under such circumstances, particularly if the actors are similar enough. However, it could be a potential source of conflict were two companies from two different states to try and mine the same asteroid, particularly if there were geopolitical considerations for the authorising States (such as say, between the United States and China). There is of course the provision in Article IX of the Outer Space Treaty against “harmful interference” with another State’s space activities but what exactly that means is unclear.

Given the cost and complexity of accessing space it seems unlikely that actual armed conflict will happen in space any time in the near future, at least beyond Low Earth Orbit (LEO). However, it is not inconceivable given the vast potential wealth available. Furthermore, it would not be unprecedented either, organizations like the East India Companies had vast navies and armies to protect their wealth and even today the resource extraction industry is not shy in employing private military contractors to protect their investments in the more dangerous

---

<sup>224</sup>US Delegation – UNCOPUOS Legal Subcommittee – 28 March 2017 1433-1441 GMT

<sup>225</sup>Comm. On the Peaceful uses of Outer Space, Status of International Agreements Relating to Activities in Outer Space as at 1 January 2018, U.N. Doc. A/AC.105/C.2/2018/CRP.3 (2018).

<sup>226</sup>John S. Lewis, *Mining the Sky: Untold Riches from the Asteroids, Comets and Planets* (Helix Books, 1997), 7-8; M. Di Martino, A. Carbognani, G. De Sanctis, V Zappala and R. Somma, *The Asteroid Hazard: Evaluating and Avoiding the Threat of Asteroid Impacts* (1<sup>st</sup> edn., European Space Agency 2009), 195; Martin Elvis, *Prospecting Asteroid Resources* in VIOREL BADESCU (ED.), *ASTEROIDS: PROSPECTIVE ENERGY AND MATERIAL RESOURCES*, 81 (Springer 2013)

<sup>227</sup>See MICHAEL K. SHEPARD *ASTEROIDS: RELICS OF ANCIENT TIME* (Cambridge University Press 2015); Martin Elvis, *Prospecting Asteroid Resources* in VIOREL BADESCU (ED.), *ASTEROIDS: PROSPECTIVE ENERGY AND MATERIAL RESOURCES*, 81-129 (Springer 2013)

areas of the developing world.<sup>228</sup> However, conflict over resources is much more likely to take the form of legal and diplomatic conflict than the armed variety. This will all have a cost of course and has the potential to undermine the legitimacy and effectiveness of the overall space law regime, especially if the existing system is unable to satisfactorily resolve disputes.

### E. E. Need for Discussion and International Coordination

The cost of accessing space makes it seem unlikely that any actor would be willing to engage in armed conflict in order to settle a dispute arising from space resource activities. However, it has to be said that humans do have a talent for figuring out how to wage war in any and all environments, and the recent discussions of the development of a “space force” in the US and elsewhere indicate that we certainly cannot rule that out as a possibility.<sup>229</sup> Although diplomatic, trade and legal strife all have their own costs and can also be significant hindrances to the development and expansion of development and commerce. Fortunately, there is still time to avoid these problems, space resource activities have not yet caused a crisis in space law, or indeed even begun in earnest. The space resources industry is still very much in development and therefore time is right to begin international coordination.

Recently it has been suggested that the Outer Space Treaty needs to be replaced or ‘updated’,<sup>230</sup> however a new treaty is likely not feasible in the current international climate. Besides given the embryonic state of the space resource activities industry a new treaty may actually be too formal and inflexible an instrument. It is to ‘soft law’ (non-binding instruments) that we should look. Given the early stage of development the industry is in and the low number of actors currently and for the foreseeable future the industry can probably get away with a significant degree of self-coordination. Some kind of code of conduct agreement would probably do the trick, though it would not be sufficient for just industry to be involved, given their responsibilities under Article VI of the Outer Space Treaty, States would have to be involved.<sup>231</sup> But the reverse is also true, it would not be sufficient simply for the states to be involved. Fortunately, the process has already begun. As discussed, The Hague Space Resources Governance Working Group is currently working on a set of proposals for an agreement relating to the governance of space resource activities.<sup>232</sup> This is a positive start.

Space resource activities have the potential to be a bonanza for human civilization. The wealth of the solar system is immense. However, there is potential for conflict and crisis. The history of terrestrial colonisation demonstrates that, and it was a repeat of the ‘scramble for colonies’ that the drafters of the Outer Space Treaty hoped to avoid.<sup>233</sup> It is not enough for

---

<sup>228</sup> Joireman, Sandra F. *Where There is No Government: Enforcing Property Rights in Common Law Africa* (1<sup>st</sup> edn Oxford University Press 2011), 108

<sup>229</sup> <https://www.theguardian.com/us-news/2018/aug/09/space-force-mike-pence-military-service>;  
<https://www.politico.com/story/2019/06/21/opinion-space-force-commerce-1374229>;

<https://thediplomat.com/2014/09/chinas-military-creates-new-space-force/>

<sup>230</sup> <https://www.ft.com/content/d67ffecc-02dc-11e9-9d01-cd4d49afb3>;  
<https://www.economist.com/international/2019/07/18/space-law-is-inadequate-for-the-boom-in-human-activity-there>

<sup>231</sup> Outer Space Treaty, Article VI

<sup>232</sup> International Institute of Air and Space Law (2017) “The Hague Space Resources Governance Working Group” Available at: <https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-for-air-space-law/the-hague-space-resources-governance-working-group> (Accessed 19 March 2017)

<sup>233</sup> Steven Freeland and Ram Jakhu ‘Article II’ in Stephan Hobe, Bernhard Schmidt-Tedd and Kai-Uwe Schrogel eds., *Cologne Commentary on Space Law*, vol 1 (1<sup>st</sup> edn, Carl Heymanns Verlag, 2009), 49; Walter A.

space resource activities to be legal; it needs to be considered a legitimate activity too. The onus is on the space resource activities industry to ensure that they are seen as ‘good global citizens.’ By participating in efforts such as The Hague Space Governance Resources Working Group at least some members of the industry demonstrate that they recognize this. Space resource activities are in their early days, there is still plenty of time to make sure the space governance regime adapts in a way that can benefit all concerned, but it will not happen by itself.

## ■ WHAT’S THE RUSH? THE CASE FOR SLOWING DOWN AND TAKING STOCK

In the wake of Planetary Resources and Deep Space Industries announcements and the subsequent enactment of legislation in the United States and the declared intent to follow suit in Luxembourg there was an abundance of interest in the legality and potential of space resource activities.<sup>234</sup> While there is arguably a general need to ‘update’ or ‘modernize’ international space law in order to give it scope to allow and/or regulate this novel activity (or prohibit it) it is also the case that, space resource activities are no more (or less) imminent today than they were in 2012. Prospecting for space resources may be an activity on the horizon, and there are reasonable concerns about the ability to adequately protect interests in prospective ‘mining’ sites (after all exclusivity is pretty indistinguishable from appropriation) but the actual activity of prospecting is little different from explorative and scientific activities which are clearly permitted by the Outer Space Treaty and broader body of space law. Further, there is

---

McDougall, *The Heavens and the Earth: A Political History of the Space Age* (Johns Hopkins University Press, 1997), 187

<sup>234</sup> Elizabeth Pearson 'Space Mining: the New Goldrush' Science Focus (11 December 2018) Available at: <https://www.sciencefocus.com/space/space-mining-the-new-goldrush/>; Andrew Wong (2018) 'Space Mining Could Become a Real Thing - And It Could Be Worth Trillions' CNBC (15 May) <https://www.cnbc.com/2018/05/15/mining-asteroids-could-be-worth-trillions-of-dollars.html>; Neel V. Patel (2017) 'Asteroid Mining Could be a Multi-Trillion Dollar Business by 2020' Inverse (28 June) <https://www.inverse.com/article/33556-asteroid-mining-multi-trillion-dollar-business-asteroid-day-2017>; Calla Cofield (2016) 'Extraterrestrial Gold Rush: What's Next for the Space Mining Industry' Space.com (21 November) <https://www.space.com/34774-whats-next-for-space-mining.html>; Morgon Saletta and Kevin Orrman-Rossiter 'All of Humanity Should Share in the Space Mining Boom' The Conversation (17 April 2016) Available at: <http://theconversation.com/all-of-humanity-should-share-in-the-space-mining-boom-57740>; Rob Davies (2016) 'Asteroid Mining Could be Space's New Frontier: The Problem is Doing it Legally' The Guardian (6 February) <https://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues>; 'Luxembourg hits on Goldmine, in space' Luxembourg Times (2 February 2016) <https://luxtimes.lu/archives/8005-luxembourg-hits-on-goldmine-in-space>; Peter Terlato (2015) 'NASA is Dreaming About Creating a Trillion-Dollar Industry from Asteroid Mining for Precious Metals' Business Insider Australia (20 July) <https://www.businessinsider.com.au/nasa-is-dreaming-about-creating-a-trillion-dollar-industry-from-asteroid-mining-for-precious-metals-2015-7>; Emily Calandrelli (2015) 'The Potential \$100 Trillion Market for Space Mining' TechCrunch (9 July) <https://techcrunch.com/2015/07/09/the-potential-100-trillion-market-for-space-mining/>; Jon Kelvey (2014) 'Is it Legal to Mine Asteroids' Slate (13 October) <https://slate.com/technology/2014/10/asteroid-mining-and-space-law-who-gets-to-profit-from-outer-space-platinum.html>; Alan Boyle, *Big-time Players are Getting Serious about Asteroid Perils and Profits*, NBC NEWS (APR. 16, 2013), <http://cosmiclog.nbcnews.com/news/2013/04/16/17782885-big-time-players-are-getting-serious-about-asteroid-perils-and-profits?lite>; Sarah Scoles, *Luxembourg's Bid to Become the Silicon Valley of Space Mining*, WIRED (Oct. 1, 2017), <https://www.wired.com/2017/01/luxembourg-setting-silicon-valley-space-mining/>; David Z. Morris, *Luxembourg to Invest \$227 Million in Asteroid Mining*, FORTUNE (June 5, 2016), <https://fortune.com/2016/06/05/luxembourg-asteroid-mining/> et al

certainly no reason to suppose that an activity that has been conducted by several government space agencies should be proscribed for non-governmental entities.

While predicting timelines for technological developments is difficult, the history of the space industry suggests that one should assume a longer development timeframe, especially when the industry is advancing such a timeframe themselves.<sup>235</sup> It seems reasonable to assume a 20-30-year development timeframe for space resource activities given that there have as yet been no prospecting missions, no mining equipment developed, and the time it takes to get to the objects that these entities wish to mine.<sup>236</sup> Therefore, especially given the demise of the two leading contenders for the status of ‘pioneer operators’<sup>237</sup> it is clear that there is abundant time to consider an appropriate regime. This is important as there is a need to accommodate several potentially conflicting aspects.

The Moon needs protecting. This does not mean a complete moratorium on space resource activities, or indeed any activity on the Moon but there does need to be a recognition that there are sites of historical, scientific, aesthetic, and cultural value that need to be protected. This is potentially true on other planets and moons but given the centrality of the Moon to humanity for millennia it is particularly true on our Moon. Furthermore, this doesn’t necessarily need any “hard law” options, a code of conduct, or some other ‘soft law’ agreement, like the space debris mitigation guidelines, that States, through their national legislation, require their nationals to comply with (i.e. it’s binding via national law but not on States via international law). There are at least two efforts underway to do things like this, be it some of the stipulations in The Hague Space Resources Governance Working Group’s Draft Building Blocks<sup>238</sup> and For All Moonkind’s registry of historical sites.<sup>239</sup>

There is also an equity and even sustainability issue to give consideration. As discussed above economically viable asteroids are not necessarily as common as we think. Therefore, there is a responsibility to ensure equitable access to resources for all states. There is a moral imperative to do this but also a legal responsibility given the provisions of Article I of the Outer Space Treaty. Therefore, there is a need to insure a reserve of (comparatively) easily accessible ore bearing objects for those States which will be late to the space mining game owing to historical and developmental handicaps. This is particularly the case if the number of ore bearing objects is towards the lower end of the scale.

It is also important to recognize that it is beneficial to allow property rights to develop from the “grassroots” and that there are potentially negative consequences for imposing a top-down system of property rights, especially when those who are doing the imposing have limited stakes in their development. Not only can it prove to be economically inefficient, especially when a “one size fits all” model is applied (as for example with the US Homestead Act which imposed a uniform model of farm on wildly different climatic areas of North America<sup>240</sup>) but it is important that the actors involved have a stake in the process, if the property rights regime doesn’t work it will be circumvented, and this may lead to conflict, which would be precisely what any international space resources activities regime would be designed to prevent.

<sup>235</sup><https://www.space.com/30213-asteroid-mining-planetary-resources-2025.html>

<sup>236</sup><https://www.universetoday.com/130231/long-take-get-asteroid-belt/>

<sup>237</sup>The Hague Building Blocks, BB 4.2(k)

<sup>238</sup>The Hague Building Blocks, BB 17(b)

<sup>239</sup><http://thespacereview.com/article/3512/1>

<sup>240</sup>Terry L. Anderson and Peter J. Hill, *The Not So Wild West: Property Rights on the Frontier* (Stanford University Press 2004), 168-174



Additionally, it is vital that property rights are enforceable, granted this should be a given, but it is potentially a bigger issue than it may seem at first. As discussed, part of the issue with the current approach being taken to the regulation of space resource activities is that it is being done at the national level. In and of itself this is not particularly an issue, and States do have an obligation under Article VI of the Outer Space Treaty to “authorise and supervise” the activities of their nationals in outer space and therefore do need a domestic legal framework for doing so.<sup>241</sup> However, in order to avoid any issues relating to the provisions of Article II of the Outer Space Treaty<sup>242</sup>, the basis for this legislation needs to be on the personal jurisdiction that States enjoy over their nationals. This jurisdiction does not extend to foreign nationals, which could make protecting property rights over space resources particularly problematic without a multilateral framework for some form of mutual recognition (as envisioned by The Hague Working Group’s Draft Building Blocks.<sup>243</sup>) Again, this is a potential source of conflict, especially if space, and space resources, come to be seen as an increasingly strategic asset.

Furthermore, property rights evolve and adapt to suit novel situations and circumstances. When miners, ranchers and farmers spread into the American West it became clear that the water rights regime that had worked well in water abundant Western Europe and had been successfully transplanted to the Eastern United States was not suitable for the arid conditions in the American west, so a new approach was devised. Similarly, in South Africa and Australia, settlers adapted and evolved property rights regimes to suit local conditions. Additionally, during the gold rushes there were shifts in the approaches to property rights in the various stages of the rushes, recognizing that there was a different need between ‘panners’ and ‘miners’ (i.e. those who panned for gold in a stream vs those who had to dig mine shafts). This ties in with the previous point about involving the people with the greatest stake in the process of developing the property rights, but it also means that there is a need to avoid being particularly dogmatic about the nature of property as applied to space resource activities and indeed any use of outer space. Space is a unique environment, drastically different from any humanity has encountered, it makes sense that property, as an institution, will have to adapt and evolve to deal with the differences.

The recent “demise” of the “pioneers” of asteroid based space resource activities, Deep Space Industries (acquired by Bradford Engineering B.V) and Planetary Resources (acquired by ConsenSys, Inc.), should be taken as an opportunity. There has been much activity, as has been discussed above, in various legislatures, at the United Nations, and through groups such as The Hague Space Resources Governance Working Group in the wake of the excitement generated by the initial announcements by Planetary Resources and Deep Space Industries several years ago, but the international community has been offered an opportunity to pause and reflect. There are still ventures pursuing space resource activities, although it now looks like the Moon is the likelier target for the first mining operations than any asteroid, but we should recognize that this is harder than and probably not as imminent as we, perhaps, once thought. While for many space enthusiasts this will be a disappointment, and indeed if humanity is truly to become a spacefaring civilization then it needs to develop an in-space economy and space resources, as well as dramatically reducing the cost of accessing space (at the very least by allowing in-orbit refuelling, reducing the quantity of propellant needed to be hauled out of Earth’s not insubstantial gravity well, as well as allowing for in-space

---

<sup>241</sup>Outer Space Treaty, Article VI

<sup>242</sup>Outer Space Treaty, Article II

<sup>243</sup>The Hague Building Blocks, BBs 4.2(b), 4.2(h), 4.3(c), 6.2, 7.1, 9(f), 10.1, 10.2(a), 11.1, 13(a), 13(b), 13(e), 13(f), 17(a), 17(b)

manufacturing thus reducing the amount of stuff needed to be brought into space from Earth's surface), will be a foundation for that economy. However, as this project is an epochal endeavour, Elon Musk might talk about building cities on Mars within his lifetime<sup>244</sup> but the task of developing humanity into a spacefaring civilization will take centuries if not millennia. There is virtue in slowing down. There is no need to rush to produce legislation or regulation for space resource activities, we have the time and the scope to give the proper care and consideration to this issue, and we owe it to ourselves and future generations to do just that. Lawyers are often accused of being reactive to events but in this instance, we have been proactive, but we need to ensure that we are not too proactive, and indeed we must strive to avoid being pre-emptive. We have the time to get this right, let us at least make an effort to not repeat the mistakes of history. The work of The Hague International Space Resources Governance Working Group and the ongoing discussions at UNCOPUOS are great first steps, but there is more to be done.

---

<sup>244</sup><https://www.space.com/37200-read-elon-musk-spacex-mars-colony-plan.html>